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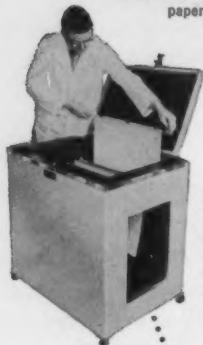
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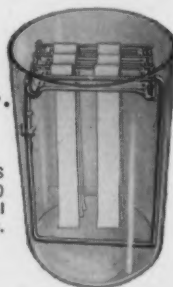
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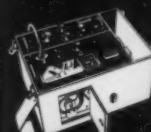
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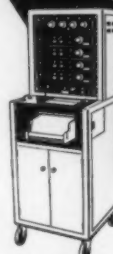
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Effective Testimony for Scientific Witnesses

Wilmer Souder*

3503 Morrison St., N.W., Washington, D.C.

THE research scientist is trained by instructors who are experts in his selected field of specialization. He reads professional magazines and converses with his colleagues. Among associates in his field, the writings and conversations are carried on from a vocabulary of words having very specialized meanings, content, and acceptance. Though quite unintelligible to the average listener, the conversations are highly meaningful to all associates. As a witness, he must present his findings in words and exhibits readily understandable by the audience.

The audience. When called to testify in a court of law, the scientist will find himself (professionally) among strangers, although all present may be citizens of his own community. Vocabularies, methods of procedure, restrictions, and evaluations will be different from anything experienced in his scientific training; even the oral examination for his advanced degree will not be comparable.

Technical expressions, unless clearly explained, have no place in testimony before the average jury. The jury, to whom a scientist is reporting his findings, knows little or nothing of his procedures, the cumulations of evidence, the precautions taken to avoid error, and the formulation of a conclusion supported by all the evidence. Unless he explains these, he loses much of his effectiveness.

Qualifying. After being sworn "to tell the truth, the whole truth, and nothing but the truth," the witness will usually find the attorney anxious to go further into his qualifications than is disclosed by a mere statement of his school training or that he is "a graduate of the state university and holds the degree of bachelor of science." The attorney will ask about his professional employment and achievements and his particular activities in the special field in which he claims excellence.

All this is necessary for the benefit of the judge who will later accept or reject the scientist as an expert. It is especially beneficial for the jury that is privileged to accept or reject his testimony and conclusions. Finally, it is needed by a court of appeals if one is called upon to reweigh the competence of the expert.

A judge is practically compelled to admit, as an expert, a graduate of a state school or a federal or state employee authorized to work in the field covered by

the testimony, unless there are irregularities in his career or in his reasonings in the special field. This is based on the judicial conception: "There must be no quarrels in the family." When the state's educational institution trains a citizen and presents him with a diploma guaranteeing certain attainments, rights and privileges, the state's judicial institution must not deny these credentials without well-documented reasons.

The expert. One definition of an expert is: "One who has acquired, by special study, practice, and experience, peculiar skill and knowledge in relation to some particular science, art, or trade." In admitting the expert, the judge usually explains to the jury that certain evidence is about to be introduced which is of a technical nature and not generally understood by all individuals. The court will now permit this expert to present the evidence and to explain its significance in the case before the court. Conclusions, if they are to be effective, must be based upon tangible and compelling evidence. They are far more substantial than opinions. Use of the opinionated expression "I think" can get an expert into sudden trouble. He is supposed to *know* or to *conclude* that certain conditions or findings *prove* the statements that he makes. It will be the duty of the jurors to weigh the evidence submitted and to give to it whatever value it may, in their opinion, deserve.

This formality may seem strange to the witness upon his first appearance as an expert. The only answer necessary for this type of procedure is that it has been found to be satisfactory over a period of many years. The expert can rightly be "eyes for the jury." He must not attempt to be "brains for the jury." If he is truly an expert, the conclusions of the jury will be the same as his. The witness should always remember that the judge of the court is the official of highest authority. His requests are to be obeyed if possible. If requested to give a categorical answer (yes or no), the witness may appeal to the judge if the question is impossible of a categorical answer. However, if overruled by the judge, he must attempt to answer it but may add: "with reservations." Counsel will give the witness an opportunity to explain the reservations upon redirect examination.

Procedures. It may come as a surprise to discover that attorneys who know little about the special field under consideration are so prominently identified with and are so vocal in the sessions. There are reasons. There are rigid regulations about admitting evidence, particularly of the type known as "hearsay" evidence, evidence about which definite facts are not available, statements not made in the presence of the accused, 819

* For 39 years a member of the scientific staff of the National Bureau of Standards. Because the author is not an attorney, references or citations to any item or conclusion herein must not be regarded as a legal opinion. The article is a summary of experiences gained during a 30-yr period of presenting scientific findings in Federal Courts.

and dozens of other regulations. Furthermore, the attorneys must screen the evidence to be presented, eliminating all irrelevant and immaterial testimony, and above all, must not omit any item pertinent to the case. Conferences at the bench between the attorneys and the judge are frequently called to decide these problems. This saves time during the trial and prevents reopening the case at a later date on a plea of new evidence (which may really be only forgotten evidence). In other words, the attorneys are charged with presenting all the evidence and nothing more. For these reasons, court procedures must (with very few exceptions) be handled through qualified attorneys. The expert will do well to accept these regulations and attempt to adapt his performance thereto.

The atmosphere. Many witness rooms are not particularly inviting. Witnesses called to testify for the defendant may be in a sullen mood. Those called to testify on behalf of the government are usually restless after waiting a few hours in a smoke-filled room. Occasionally, the expert witness is invited to wait in counsel's office or library.

In one court where three cases were being tried, special exhibits (charts showing handwriting) were reluctantly admitted in the first case. The accused was convicted. In the second case, the court was requested and agreed to omit the special exhibits. The witness went to the blackboard and made comparisons of agreements in writings. The accused was convicted. In the third case, it was agreed that no charts or blackboard would be used. The witness used scratch paper and a wax crayon to make the comparisons. The third accused was convicted. Substituting a pad for a blackboard may have been near "contempt of court." The witness chose to take the chance and escaped without citation or penalty.

The Witness and His Testimony

Qualified expert. When qualified as an expert, a witness is elevated to one of the highest positions in the court. The judge has vouched for his professional attainments and ability. The expert should maintain the poise and dignity of a professional man and do nothing to make the judge regret his action. He should rise, not "swell," to the position.

Meekness or dignified reserve will inspire confidence in his integrity and will enhance the weight given to his testimony and conclusions. Meekness is in no respect related to weakness, indecision, or fear.

Fear. Anxiety and a degree of fear are normal for the conscientious man who wishes to present the evidence in the most effective manner. Thirty years of experience has not removed it completely from one man.

A prominent professor in one of our leading universities gave very helpful assurance to his students when he reminded them of their preparation and attainments. Have no fears, he said, when you appear as an expert in court to testify on matters covered by your training. When you graduate from this school, you will know more about the subject than any attorney in the United States and as much as any other graduate. You will always know what the attorneys are talking about, unless they attempt to confuse you

with ambiguous or trick questions. You should recognize these in time to protect yourself.

Superior evidence. Answers to questions on qualification should be straightforward and addressed to the jury. Show no special appreciation of the "glamorization" that was applied to your abilities. Keep in mind that the evidence you develop is of much greater significance than your personal record. Facts are your total asset. They are all you need. The opposing counsel may call more handsome and better dressed experts. Unless you develop better evidence, use better reasoning or build better foundations and support for your conclusions, you will lose.

Every real expert will admit the limitations to his abilities and the fact that there are borderline cases. On such cases, he will give no positive conclusion.

The jury. Size up the jury as composed of businessmen, financiers, laborers, servants, housewives, and college professors. Fix in your mind the conclusion that each member is equally important and is earning an honest living.

If you do not speak loud enough for each juror to hear and understand every word, you are not a top expert. Unless your explanations are clear enough to be grasped by the most critical juror (and all other members) you are weak. Loss of only one juror in criminal cases means a hung jury and a total loss of the effort. Study the expressions on the jurors' faces. If one looks at another with a blank expression, you may wish to make another attempt to explain the point you have tried to make. When you make the evidence speak, you have achieved your mission. The jury may lose all interest in your personal achievements, dress, and reputation and may become saturated with the evidence. This is perfect testimony.

Cooperation. You have previously gone over your testimony with associates at your laboratory and with the attorney who sponsors your testimony. (This is standard procedure.) If asked whether you have discussed your testimony with others, say, "Certainly." (Many lay witnesses will answer "No" and later have to change the answer to "Yes.") No one dares tell you what to say. Any conclusion expressed must be yours. When you are qualified as an expert, you are on your own.

If the attorney repeats a question with little apparent change in the wording, you may be sure that your first answer was not complete. In your preliminary conferences, you have told him something or expressed a conclusion that you forgot to include in your answer. He is trying to get you to tell it to the jury just as you told it to him.

Cumulative testimony. Your testimony and outline of procedure in making examinations and tests should show an open-minded approach to the problem. They must be explained to the court. Gradually the findings suggested a conclusion. This was further supported by additional findings. When the conclusion seemed positive, you made additional tests to see whether an opposite interpretation could be justified. Finding no support for any other conclusion, you summarized the tests in the following conclusion: That the signature

John Smith on exhibit 1 (hold it up before the jury) was written by the individual who wrote the exemplars designated as known writings of William Jones and shown on exhibit 5. Hold both exhibits up before the jury. Conclusions must be clear, complete, and as simple as possible.

The bank cashier who sums up his testimony in the line "I would pay money on that signature," has left a conclusion not easily bowled over.

Quick answers. Take time to think over all questions. If you snap back answers to the attorney before he completes the question and slow up on cross-examination, it will be noticed by the jury and may be interpreted as "in trouble." Also, an attorney may shoot a fast, ambiguous question and get you in real trouble.

Acc in the hole. All pertinent testimony must be given or mentioned during direct examination. Some attorneys prefer little detail at that time. They ask for the conclusion and then turn the witness over for cross-examination, the theory being that cross-examination will hurt the cross-examining attorney and discredit him before the jury. Enhancements of a conclusion while you are under cross-examination are devastating to the opposition. But suppose there is no cross-examination and the opposition uses other experts who make impressive presentations of unimportant items. Double efforts will now be necessary to take the emphasis off these unimportant items and then to direct it to the important items.

The degree of certainty of a conclusion, expressed mathematically, is complicated and should be mentioned only during the direct testimony. Let any confusion that may develop on explaining come to the cross-examiner.

Notations. If during the testimony something comes to mind that is important and should be elaborated, you should make a note on the back of your exhibit, notebook, or card. If the attorney asks what you are writing, tell him, let him see it, and say that it is important. Above all, it will be a signal to your attorney to find out what you have written and to elaborate that part of the testimony.

Exhibits. Photographs and simple exhibits are very important. They impress the facts through an additional sense. They continue to testify after the expert leaves the stand.

Simple equipment may be introduced for use in showing details of an item. Simple hand-lens magnifiers are always appropriate when they will bring out a detail. Compound microscopes are not easily adjusted by those who do not use them regularly. There is always a question about what they see or do not see. Finally, you may be asked by opposing counsel to explain the operation of the instrument. Can you explain to 12 individuals what values are attached to apochromatic lenses, numerical apertures, depth of focus, or dark-field illumination sufficiently to convince them that you yourself know their functions? Perhaps a statement that this microscope is an accepted instrument such as is used by all federal and state laboratories will be a sufficient answer.

Records. Witnesses may refresh their memory by

referring to records (preferably original). They are not permitted to read from the record book. They may only look at the book, then look at the jury, and state their findings. Records so used may be inspected by the opposing attorney in their entirety (all pages related to the case). Erasures, wisecracks, or other extraneous material on a page may have to be explained.

Original documents. Wherever possible all identifications must be made on original documents. This brings up the question: Why have the models or photographic exhibits? Exhibits are made to aid those with faulty vision to see much of what was seen under the microscope, to assemble conveniently the parts of the documents used, to preserve a record, and to furnish support and protection for the expert. Graphs are used to summarize data or to show trends in events. Everything in the graph is in the data.

Photographs or photostats introduced must be identified and authenticated as accurate photographic reproductions of the originals made under the instructions of the expert. At one time it was necessary to produce the photographic technician to identify his work, but this is no longer mandatory.

Disclosing evidence to the opposition. Attorneys occasionally request permission to see their opponent's evidence. This may be granted by special agreement between the attorneys and the court. Such disclosure usually brings a plea of guilty if the case is called for trial.

Press relations. Releasing information to the press is a function of counsel's office. As an expert, you know only one phase of the case. You may not be called to testify. To give pertinent information prior to your testimony will weaken your prestige before the jury. They expect and have a right to hear it first. Reporters' promises to hold the information until after you have testified are not always dependable. Refer all requests for interviews to the attorney who called you to testify.

Unpopular prosecutions. Unpopular prosecutions are to be taken in stride. If the parties concerned wish to have the issues settled in court, it is your duty to present the evidence. The jury will do the right thing in cases where there are mitigating circumstances.

Cross-Examination

Complete answers. When testimony and explanations are hurting a case, the opposing attorney may attempt to stop the witness by asking a new question. Most lay witnesses will accept the new question. This is a victory over the witness. He should say: "I have not completed my answer." If the judge rules in favor of the new question, your attorney will make a note and will, on redirect, give you a chance to complete the answer.

Multiple questions. Some attorneys specialize in involved questions and hope for a single answer that may be correct for the last part of the question but not for the first or middle part. It is always proper to respond with: "That seems to be a triple question. Do you wish to separate it or shall I do so?" Another

way is to ask the clerk please to repeat the question, then answer each part separately.

Praise. When the opposing counsel begins asking questions that seem to build you up and all answers are "Yes," "Yes," and so forth, be extremely careful. He is maneuvering for a quick answer, which if answered without due consideration, may hurt your qualifications or the accuracy of your statements.

Distorted answers. It is not uncommon for a cross-examiner to repeat one of your answers given in direct testimony with cunning distortions. You may reply: "I am sorry if I did not make the point clear. I do not recall saying it in exactly that way. If I did, I am grateful for this opportunity to correct it. What I should have said is '...'." Make it clear this time. Some prefer to ask the clerk please to read both the question and answer before correcting it. If the answer is worth the attempted distortion, it is important and may well be emphasized by this opportunity to reexplain it with all details—under the sponsorship of opposing counsel!

One of the best witnesses responds as follows: "No it was not that way. Let's get it straight. I'll tell you exactly how it did happen." He then repeats his testimony almost word for word and explains why the distorted statement cannot be true. Above all, you must not become angry or show any desire whatever to convict the accused. Convicting is definitely the prerogative of the jury or court.

Stinging retorts. There are frequent opportunities to make stinging retorts to snide questions. To do so will remove emphasis from the item of most importance. You may be able to embarrass the examiner but will most surely develop sympathy for him on the part of one or more jurors.

A report. Another trick question ambles along this theme: "Now let's rehearse the happenings. These documents were obtained by counsel; they were brought to you by Mr. Brown who asked you to examine them and identify Mr. Young as the writer." The reply is: "No, that is not correct. I was requested by Mr. Brown to compare the documents and make a report. This I did." The examiner may ask to see the report. The reply is: "The report was sent to counsel, I have no objection to your seeing it."

Ostentation. Should a pedantic question be asked, such as "What is your attitude toward holographic documents," and you are not sure of the meaning, you may ask for the popular expression used to describe such documents or for an explanation of what is meant. If you do know the meaning, be sure to explain the meaning of the word before answering. The jury will thank you for doing so.

Fishing. When opposing counsel's case is weak, he may ask very queer questions, apparently not related to the case. These questions may relate to your knowing a certain individual. First, he may ask if you ever knew Osborn the great document expert. Next, are you acquainted with the writings of the authority Alfred? There is probably no important document authority by this name. If you answer "Yes" and there

is no such authority, you will be exposed and discredited. This practice of fishing for a lead, which may profitably be followed up, is quite common among poor attorneys.

Authorities. Be careful about giving unqualified endorsements for any textbook, magazine, writer, or official. Do not claim to know every line, written on any subject. You should be able to name one or two textbooks, an abstracting magazine, or an individual whom you regard as a leader in the field. Unqualified endorsements of a textbook are almost surely followed by reading a paragraph from the book which may be interpreted as weakening your findings. If you can say you regard an author as a leader and, in general, you have found him reliable, you are protected. To establish your degree of expertness properly, you must admit that there are others who know the subject and with whom you have discussed problems, although not always accepting their opinions blindly.

As a layman. The routine procedure on cross-examination to try on a document expert is to present two documents and ask whether they were both written by the same individual. Obviously, identification in the case at issue was not completed in 2 minutes, neither can this comparison be made without extended study under instruments and with hours of time. Counsel should counter with: "It has not been shown that these documents are pertinent to this case. If opposing counsel wishes expert service he should procure it through proper channels."

If left to the expert to respond, he may volunteer the following: "If I may offer an expert's curbstone opinion, I would say that they have some similarities in general appearance. Also, there are differences that may or may not be disguise. I do not advocate, nor do I voluntarily indulge in giving, such opinions. Upon proper request from the court and authorization, I shall gladly make a study of the material and report agreement, nonagreement, or my inability to come to an unqualified conclusion. I am not prepared to specify what reimbursement will be asked."

If the judge approves and insists that the study be made, the expert will request that the known document be marked, that several exemplars of the known writer be supplied, that some of these be from writings made prior to the writing of the questioned document, and that the cooperation be as complete as that supplied in the case at issue. Insist upon being allowed as much time for this study as was used on the case before the court.

Success. The honest expert never looks upon the outcome of his work as a result of luck, the reward of a game, or victory in a battle of wits. He has built his qualifications through hard work. He establishes his conclusions through exacting procedures; he presents his testimony in the face of keen opposition and asks no favor beyond an honest consideration of the facts disclosed. Having done so, he has fulfilled the high obligations of his profession.

Justice is sometimes pictured as blindfolded. However, scientific evidence usually pierces the mask.

The Work of Richard von Mises: 1883-1953

Philipp Frank

Harvard University, Cambridge, Massachusetts

RICHARD VON MISES was born April 19, 1883, at Lwow, which belonged at that time to Austria. He was teaching as professor of applied mathematics from 1909 to 1918 at the University of Strassburg, from 1920 to 1933 at the University of Berlin, from 1933 to 1938 at the University of Istanbul, and from 1939 to 1953 at Harvard University. He died July 14, 1953, in Boston.

His field has been officially labeled "Applied Mathematics and Mechanics." In the community of scientists, one often meets the opinion that work of this kind preoccupies the mind with highly specialized technical problems and does not leave much room for broad generalizations or abstract theories let alone philosophical implications. Yet, in looking over the work of v. Mises, we cannot fail to recognize a whole spectrum of research, extending from the philosophical meaning of science to practical methods of numerical computation. v. Mises was always a truly broad-minded man, who found problems to suit his interests in many fields and turned his searchlight in many directions, picking up results wherever the picking was good; but, notwithstanding the wide range of his topics, his work shows great intrinsic unity: starting from a definite center, it branches out in systematic investigations of a great diversity of problems. Thus it would be a misinterpretation of his work if it were considered as the output of a versatile man who split his interests because he was casually attracted by many topics. Actually, v. Mises chose the topics according to a very definite viewpoint, determined by his ideas about the essence and method of every thoroughly scientific research.

As v. Mises saw it, applied mathematics is the field of central importance for every attempt at a philosophical picture of our world. In drawing such a picture, the central task is to understand the relationship between the direct sense observation of the experimental physicist and the conceptual system of science, which consists of expressions such as "increase of entropy" or "principle of relativity." Most physicists are inclined to say that the picture drawn and the principles devised by our inductive ability are eventually checked by actual measurement of physical quantities like length, weight, electric charge, and so forth, but they use the expression "measurement of a length" in a perfunctory way, forgetting that no numerical value can ever be assigned to a length by a single measurement. In fact, a long series of measurements is needed from which eventually "the value of the length" can be computed.

In contrast to the procedure of the physicist, applied mathematics concentrates its efforts on the prob-

lem: how can "values of length" be computed from sets of different readings? And, in a general way, it has become the business of applied mathematics to investigate the connection between "direct pointer readings" and the abstract conceptions (as length, or electromagnetic field) that occur in all laws of science—in Newton's mechanics as well as in Maxwell's theory of the electromagnetic field. This *problem of connection* between sense observations and abstract principles has always been the critical point in the philosophy of science. As we see the problem, it is tackled most precisely by the methods of applied mathematics, and it is in this sense that v. Mises dealt with the tasks of "Applied Mathematics and Mechanics," building upon the ideas of the great Austrian scientist and philosopher Ernst Mach, who regarded both science and its philosophy as theories of sensations.

Investigating this problem of connection, v. Mises discovered soon the all-important role that statistics plays in this task. He examined and presented this role in a precise and lucid way and removed the obscurity that had been inherent in the traditional presentation of statistics and probability.

Thus a very rational line of thought connects v. Mises' work in mechanical engineering (*Theorie der Wasserräder, Fluglehre*, and so forth) with his investigations into the logical foundations of probability. If we study his work in fields of such complex structure as plasticity or turbulence, we never find smug contentment with rules of thumb or quick transitions from a vague assumption to a long row of figures but meet everywhere the attempt to analyze these difficult problems in terms of rational mechanics and to examine critically traditional assumptions. We see him, on the other hand, freeing probability theory from semimystical formulations, according to which the concept of probability is derivable from our "ignorance." To do this, he had to construct an axiomatic system, based, as is every physical theory, upon the combination of a formal system and the physical interpretation of its terms. In probability, as well as in mechanical engineering, v. Mises investigated the complete range of problems that stretches from the construction of a suitable axiomatic system to methods of numerical computation. Looking at the great variety of topics in his papers, we may marvel at the broad abilities of the author, but we must admire the work of a mind that is forever searching for the central problem hidden under the apparent variety.

v. Mises summed up his ideas in several books, which are not the least known for the attractive presentation of topics that had suffered greatly in earlier

presentations. Coherence in the large and precision in the small—both intimately connected with the nature of v. Mises' work—reappear in his style and give depth and clarity to his writing. With the *Differential- und Integralgleichungen der Mechanik und Physik*, he gave to those who wished to apply modern mathematics to physics and engineering problems, a lucid account of the mathematical fundamentals. This work, which first appeared in 1925, was reproduced (in German) in the United States during World War II for the benefit of all those working in defense research. In *Probability, Statistics, and Truth*, v. Mises offered a brilliant presentation of his general ideas on probability to a wider class of readers; it is perhaps still the best book to make a general scientist or, for that matter, any well-educated person familiar with the conception of probability and its applications.

In *Positivism, a Study in Human Understanding*, v. Mises gave us a summary of his views on many topics in science and life. In this book the word *positivism* is not meant to designate a sectarian doctrine of some philosophical school; v. Mises used it, rather, to characterize a way of presenting his views that takes its cue from the methods of science and should establish understanding among those willing to drop prejudice and accept what experience and reason sug-

gest. Throughout the whole book, v. Mises did not fail to emphasize that the role played by human imagination is not less important in the invention of scientific theories than it is in the works of art and in religion. Perhaps it is best to characterize this book by the author's own words:

Positivism does not claim that all questions can be answered rationally, just as medicine is not based on the premise that all diseases are curable, or physics does not start out with the postulate that all phenomena are explicable. But the mere possibility that there may be no answers to some questions is not sufficient reason for not looking for answers, or for not using those that are attainable.

He stressed the point that too many people interpret the present world struggle as a battle between two ideological systems of extremely metaphysical character:

If this goes on, the predictions of those who believe that the next step toward the solution of the basic sociological problems must come from physical annihilation of one of the two groups of people will be borne out.

In our opinion, the only way out is less loose talk and more criticism of language, less emotional acting and more scientifically disciplined thinking, less metaphysics and more positivism.

A Golden Anniversary

W. L. Everitt and J. F. Downie Smith

University of Illinois, Urbana, and Iowa State College, Ames

ENGINEERING research in our nation's colleges and universities has become a multi-million dollar operation. But still more important than its magnitude have been its effects. This research effort has been and is influencing the engineering education of both undergraduate and graduate students. Furthermore, the results of engineering research programs being conducted in our educational institutions represent valuable contributions to the growth of industry and to the national defense effort.

This year both the University of Illinois and Iowa State College are celebrating the 50th anniversary of their Engineering Experiment Stations. These research organizations, the first of their kind in the nation, were founded in the academic year 1903-04. They have been active and growing in size and concept ever since.

Before 1903, such research as was conducted in engineering colleges was done on an informal basis. In keeping with the systematization of agricultural and forestry research at the turn of the century, and

with the industrial efficiency movement, the faculties at both Iowa State and Illinois believed it was necessary to formalize their research activity and provide a means for conducting research programs under the sponsorship of industry, state organizations, and engineering societies. In addition to furnishing useful information to these sponsors, they recognized that such research projects would provide graduate and undergraduate students with training in research methods and that the knowledge gained by them would represent advances in the science and art of engineering. Both schools also recognized the necessity for publishing research results in order to obtain the maximum benefits from their research programs. This is evidenced by the fact that each station issued its first bulletin during its first year of operation. In the course of the past 50 years, both stations have published numerous bulletins and have contributed, through their research staffs, a still greater number of papers and articles to the technical press.

Today both industry and government recognize the importance of research in the growth and security of

our highly technical society. Three groups—industry, technical societies, and the government—have continued to support research programs in engineering experiment stations and other university-affiliated research organizations.

Industry, either as private companies or through its trade associations, has supported applied research in a variety of fields. Recently a number of industries, recognizing the importance of basic knowledge to their progress, through gifts and grants have supported projects of a fundamental nature.

Technical societies for many years have supported research programs in their areas of specialization. Furthermore, through their technical advisory and research committees, they have served as coordinating agencies for industry-sponsored research being conducted by universities.

The government agencies supported relatively little research prior to World War II. However, the work they did support was very productive. For example, the highway programs they have supported have increased safety and reduced costs of highway systems all over the country. During and immediately after World War II, various defense agencies and the Atomic Energy Commission sponsored a considerable amount of both basic and applied research. Often this research concerned complex problems dealing with defense systems and requiring many research workers from different disciplines. Such "team" operation brought natural and physical scientists and engineers together and provided a very satisfactory method, if not the only method, for solving complex system problems of interest to the defense effort.

This is a golden anniversary in another important sense. The application of research results from these two experiment stations alone has saved millions of dollars. Often the returns have been several hundred times the cost of the project to the sponsor. The results of research on problems related to our national defense are hard to put in terms of dollars saved, but benefits from new equipment, simplification and improvement of existing equipment, and fundamental information needed to make technological advances for the future are vital to the defense program. In these activities, universities, industry, and the government have worked together—each contributing to the over-all program. In addition to conducting comprehensive research programs, our experiment stations, as well as those of other universities, are providing training for research personnel needed to man governmental and industrial research posts.

Research, being a quest for answers to the unknown, has provided new principles of engineering and the sciences on which engineering is based. Even in applied research, where application of known principles is the primary objective, the projects provide a better understanding of fundamentals. By maintaining a close working relationship between the research and educational activities, these new principles and elaboration of known principles that are obtained through

the research program provide valuable educational material. In fact, it is largely due to research conducted in engineering colleges that we can attribute our present emphasis on teaching fundamentals and the concomitant decline in student time spent on merely manipulative and descriptive techniques. Nearly all curriculums show the effects of these changed concepts; progress has been especially noticeable in such fields as mechanics, thermodynamics, electronics, and solid-state science. At the present time, the concepts derived from research in solid-state physics are being utilized in various fields such as metallurgical, ceramic, electrical, and mechanical engineering. Plans are now being formulated for the introduction of course material into the curriculums of these departments through conferences sponsored by the American Society for Engineering Education and the National Science Foundation. A similar program is being conducted to introduce the concepts of nuclear engineering to various engineering curriculums.

Technical advances through research have also intensified the need for continuing education for engineering and science graduates. Research results provide material for such adult-education programs as short courses, conferences, and seminars. Publication of research results also provides an educational medium for those who wish to keep abreast of new developments.

The complexity of modern engineering research has introduced several problems that are currently affecting the method of conducting our research programs. One of the major problems has to do with the large amount of technical material published in various fields. Today a comprehensive study of the literature covering past works in a given field of interest often requires more effort than was necessary to complete an entire project on the subject of 50 years ago. This situation has resulted in specialization of research personnel in order to minimize the time required for a survey of background material. A group of such specialists then works as a team to handle the large complex problems. In many cases, the team method of operation produces results that would not otherwise be practicable. However, this method of research is expensive and tends to inhibit individual creativeness. There is need for better support of the individual researcher through computing services, abstracting services, literature-search facilities, instrumentation services, and so forth. There is also a need for better methods of indexing material and for the communication of research results to avoid undesirable duplication of effort and wasted time and motion.

The complexity of research also introduces the problem of maintaining close relationships between teaching and research. As previously mentioned, this is desirable if education is to get maximum benefit from research. An individual research worker can divide his time between his project and teaching without undue complication. However, when he is part of a team working on a large project, it is much more

difficult to provide contact time for students to study under him. The experiment stations at Illinois and Iowa State have made a concerted effort to provide for teaching and research combinations and have been quite successful in spite of the difficulties mentioned in foregoing paragraphs.

The present high level of research expenditures is primarily due to government-sponsored defense and atomic-energy research projects. In addition, some projects sponsored by industry are in fact government-supported programs that are being subcontracted to universities. If we are to continue to derive the benefits of engineering research, some means of financing must be provided in order to maintain an active research program within engineering colleges at such time as defense research funds are decreased. The National Science Foundation was conceived in order to provide support for basic research and to encourage the training of scientists and engineers. However, the funds that have been made available to this organization are still very small compared with those now

being expended by the Defense Department and the Atomic Energy Commission. It is hoped that in the future additional funds will be made available to the National Science Foundation for support of research grants and graduate fellowships in proportion to the reduction of research funds that are now provided through other government organizations.

Industry is now supporting increased amounts of basic research. In addition to the specialized research program directed toward the direct solution of industrial problems, it is also providing funds for more graduate fellowships to support students interested in research training. These graduate students are in demand for research work in both industry and government. Thus, by means of research grants and fellowships, industry is making possible the training of research personnel as well as receiving the direct benefits of the research program. A greater amount of support by industry of university research is highly desirable; particularly if government support decreases.

News and Notes

Venezuelan Guayana Expedition

The New York Botanical Garden has brought to a close its 14th botanical expedition to the Guayana Highland of Venezuela, adjacent to British Guiana and Surinam. This program of exploration, begun in 1944 with expeditions to the Kaieteur Plateau in British Guiana and the Tafelberg in central Surinam (Netherlands Guiana), will come to a conclusion during the 1954-55 seasons with a second visit, in conjunction with the Chicago Natural History Museum, to Chimanta-tepui in the Gran Sabana of southern Venezuela in the state of Bolívar, and a visit to Tepequem on the Brazilian side of the Pacaraima range, which forms the watershed boundary between southern Venezuela and northern Brazil. Support for the conduct of this program of explorations as a whole has come from many sources, but the current expedition was carried out under a grant made to the Botanical Garden by the National Science Foundation, the terms of which provide also for the forthcoming trips to the Cerros Tepequem and Chimanta-tepui.

The expedition that has just returned was conducted by three staff members of the N. Y. Botanical Garden—Bassett Maguire, curator; John J. Wurdack, assistant curator; and George S. Bunting, assistant—who left New York on Oct. 7, 1953, and returned Mar. 4, 1954. This group explored mountains near the remote Brazilian frontier which had been seen by the previous expedition.

The objectives of the trip were two-fold: first, to make botanical collections, which might be expected to yield plants of the character and high endemism that had been previously exhibited by those from the fa-

mous Cerro Duida lying 150 mi north; and second, to make inquiry into the geology, determine the proportions, and record the positions of these new mountains.

To facilitate the exploration, the U.S. Ambassador placed the Embassy plane at the expedition's disposal. On Oct. 31, a 7-hr reconnaissance flight of some 1200 mi was made from Ciudad Bolívar across the mountainous and jungled region of southern Venezuela to the Brazilian frontier. This established without question the existence of extensive ranges along the Brazilian frontier and, further, the existence of a system of lofty sandstone plateaus northward of the frontier, well within the limits of Venezuela.

The expedition then embarked that same day at Ciudad Bolívar on the Río Orinoco. It traveled more than 1500 mi by river steamer, outboard motor, and dugout up the Orinoco, down the Casiquiare, and into its large blackwater affluent, the Pacimoni. On Dec. 13, the party reached its base camp, which was established in *guapó* forests (flooded lands) in the headwaters of the Pacimoni. Eighteen days and 5 camps later, on Dec. 31, the group arrived at the summit camp—altitude, 5500 ft—and there it remained until Jan. 23. The base camp was broken on Jan. 30, Ciudad Bolívar reached on Feb. 24, and finally New York again on Mar. 4.

The ornithological expedition of Mr. and Mrs. William H. Phelps, Jr., of Caracas joined the expedition for a period, reaching the base camp on Jan. 12. Alexander Wetmore of the Smithsonian Institution of Washington; James H. Kempton, Agricultural Attaché of the U.S. Embassy, Caracas; and Charles Reynolds, geologist of the Orinoco Mining Company,

who was attached to the Botanical Garden expedition, accompanied Mr. and Mrs. Phelps.

Scientific results will be reported at a later date. It may be said, however, that the botanical findings were commensurate with early expectations. The ornithological collections have proved these mountains to have an exceedingly high ratio of endemic avifauna. The mountain itself, one of several sandstone or quartzite massifs probably exceeding 8000 feet in altitude, will be described more fully when the geologic and geographic data have been evaluated. The nomenclature of the frontier ranges and the system of sandstone table mountains will be worked out in the light of the new findings and the scanty historical data available. Richard Spruce, the pioneer South American botanical explorer, visited this area 100 yr ago and almost certainly approached at least one of the smaller sandstone mountains to its base.

BASSETT MAGUIRE

New York Botanical Garden

Science News

The following statement by the Executive Committee of the Federation of American Scientists has been released by M. Stanley Livingston, chairman.

The majority report of the Personnel Security Board which heard the Oppenheimer case bears the imprint of fair-minded men struggling unsuccessfully against the pressure of a security system extended beyond reasonable bounds. The report finds Oppenheimer to be unquestionably loyal to this country.

Evaluating the charges relating to his past associations and beliefs, the report finds that they would not in themselves affect his clearance. It finds no substantiation for the charge of overt efforts to impede or slow the H-bomb program. Nevertheless, it finds it impossible to recommend his continued clearance because of: alleged lack of enthusiasm for the H-bomb program, serious disregard of security requirements, susceptibility to influence, and "less than candid" testimony before the Board. And this despite the findings that Oppenheimer has displayed "a high degree of discretion reflecting an unusual ability to keep to himself vital secrets" and that the nation owes him "a great debt of gratitude for loyal and magnificent service." It is ironic that this service included a major role in producing many of the very secrets the security system is designed to protect.

We believe the majority findings to be unfair to Oppenheimer. But more than that, we believe them to illustrate the dangers and the bitter fruits of a security system which is now motivated more by the risks of politics than the risks of disclosure of information. The Board itself recognizes that much larger issues are involved in this case; it notes that the reopening of the Oppenheimer case is the result not of a change in Oppenheimer but of a change in security regulations and the climate of national opinion.

If it does not make sense to find risk in a man who has proven himself in the most secret councils of government—and we believe it does not on the evidence so far provided—then attention must be directed to the security system under which the case has arisen. The fault lies,

at least in part, in criteria so loosely and generally drawn that they can even admit to serious consideration, in estimating security status, such fantastic assertions as "lack of enthusiasm" for official policy. The threat lies in the use of security machinery to dispense with technical consultants whose views may no longer be acceptable to the administration in office. The danger lies in the discouragement of independent minded men, including many scientists, from lending their talents to government.

We hope that the Atomic Energy Commissioners will again review the record and, within the bounds set by law and Executive Order, do justice to Oppenheimer as an individual. But beyond that we urge strongly that the entire machinery of security must itself come under review. The American people are seeing samples of the mixing of politics and security in such highly publicized proceedings as the . . . [certain current] hearings. It is to be hoped that these hearings will attract attention to the underlying problem—the exploitation of legitimate concern for national security for political ends. Security machinery has only one justification, to protect a small area of vital national information. It cannot efficiently do more; it cannot do more without sapping our national strength and eventually destroying our traditions and practices as a free people.

It has been necessary to assume, until recently, that the rate of oxygen consumption by photosynthetic organisms is the same in the light as in darkness. Thus, a correction for the dark respiratory rate was applied to the "apparent" photosynthetic rate to obtain the "true" photosynthetic rate. Recently, studies on respiration rate in light have been made possible by the use of mass spectrometer analysis and heavy isotopes of oxygen [Brown, Nier, and Van Norman, *Plant Physiol.* 27, 320 (1952); Van Norman and Brown, *Plant Physiol.* 27, 691 (1952); Brown, *Am. J. Botany* 40, 719 (1953)]. Through the use of oxygen 18 to label oxygen in the reaction vessel, and by following the isotope dilution, the processes could be studied simultaneously in the light: $\text{CO}_2 + 2\text{H}_2\text{O} \rightarrow (\text{CH}_2\text{O}) + \text{O}_2 + \text{H}_2\text{O}$ (photosynthesis); $(\text{CH}_2\text{O}) + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ (respiration).

A steady decline in the concentration of O_2^{18} was observed, owing to respiration; the disappearance occurred at a steady rate whether in the light or in the dark. Simultaneously, unlabeled oxygen released from water during photosynthesis increased in the light and decreased in the dark, owing to respiration. Thus, light was demonstrated to be without effect on the respiration of a photosynthetic organism. These methods have been applied to the study of several strains of algae and certain higher plants. From this work it is therefore demonstrated that light is without effect on the respiration of photosynthetic organisms, and thus a firm basis is supplied for the afore-mentioned correction to obtain the "true" photosynthetic rate.—W.J.N.

An Army dentist, Col. George T. Perkins of Walter Reed Army Medical Center, has invented a new electronic thermometer, the "Swiftem," that will give an accurate reading in 5-7 sec. It works through a carbonyl thermistor at the end of a stainless steel probe.

The probe, which goes into the patient's mouth, is connected by a flexible transmission cord to a battery in a plastic handpiece small enough to fit in the palm of the hand. On the handpiece is a meter that registers the temperature. At an Army hospital, the new thermometer made it possible to take ward temperatures in one-fortieth the time formerly needed. The new device, the first change in clinical thermometers since the mercury-column type was introduced in 1867, is being manufactured by the Burlington Instrument Co. Hospital models will be on the market in 60-90 days.

The first phase of a long-range **sky-mapping program** designed to yield better insight into the true rotation of the Milky Way has been completed at the University of California's Lick Observatory. C. D. Shane, director of the observatory, and his colleague in the study, C. A. Wirtanen, observer, have reported that the last of 1246 plates has been taken, comprising a complete map of the sky as seen from the Northern Hemisphere. Each of the plates is 17 by 17 in., and required an exposure of 2 hr.

The project was conceived originally by W. H. Wright, director emeritus of the Lick Observatory, who is now living in San José. The sky map, when compared with a second one to be taken beginning some 10-12 yr hence, will provide data from which the Galactic rotation and mass can at last be accurately calculated.

Average **length of life** in the United States has reached a record high of 68½ yr, a gain of nearly 4 yr in the past decade, according to vital statistics compiled by the Public Health Service of the Department of Health, Education, and Welfare. Women on the average live longer, outliving men by 6 yr. The average lifetime expected for women at birth is 71.8 yr, while for men it is 65.9 yr. This difference in the life expectancies of men and women has increased sharply since 1900, when females outlived males by an average of only 2 yr.

White women at birth have a life expectancy of 72.6 yr, compared to 66.6 yr for white men. Non-white groups have a shorter average life—59.4 yr for nonwhite men, and 63.7 for nonwhite women. Although white persons outlive nonwhites by an average of 8 yr, the difference between the two groups has narrowed since 1900, when white persons lived about 15 yr longer than nonwhites.

The need for easily available steroid preparations for use as reference standards in connection with the rapidly developing paper chromatographic techniques was recognized by the Endocrinology Study Section of the Division of Research Grants, National Institutes of Health, as early as 1952. This situation was brought to the attention of the Board of Trustees of the United States Pharmacopeial Convention, and in 1953 a U.S.P. Advisory Board on **Steroid Reference Substances** was established. The membership is as follows: T. F. Gallagher, Sloan-Kettering Institute; Gregory

Pincus, Worcester Foundation; Max Tishler, Merck & Co.; Adley B. Nichols, U.S.P.; and Sam R. Hall, Division of Research Grants, N.I.H. (chairman). This board is responsible for the selection of reference substances, verification of their authenticity, and determination of their suitability.

The first set of reference substances, consisting of the 24 steroids considered to be the most needed for paper chromatography, is now available. Other sets will follow, and suggestions for future additions are welcomed. Income from the sale of these substances, over and above packaging and distribution costs, will be used for expanding the program. The price is \$3.00 for a single steroid and \$60.00 for the complete set of 24. All inquiries concerning the Steroid Reference Substances should be directed to U.S.P. Reference Standards, 46 Park Ave., New York 16.

The Atomic Energy Commission has announced an agreement with five utility companies of the Pacific Northwest to study nuclear reactors as producers of electric power. The study is the first to be undertaken in the Northwest, where there is a growing demand for new energy sources. The project brings to 13 the **nuclear power studies** sponsored by the Commission.

In 1953, 1072, or 6 percent, of the Nation's public **water-supply systems**, were unable to meet the peak demands of their customers. About 15 out of every 100 persons using public water supplies were affected. In an attempt to discover whether the shortages were caused by drought or by a failing of man, the U.S. Geological Survey made a reconnaissance inventory of the adequacy of public water systems throughout the United States. The inventory included all 48 states, of which only Idaho, Mississippi, and Rhode Island reported no shortage. Most of the shortages were caused by municipalities outgrowing their systems. A report, "Public Water-Supply Shortages, 1953," prepared by K. A. MacKichan and J. B. Graham of the Water Utilization Section, Water Resources Division, may be obtained free from the Water Resources Review, Geological Survey, Washington 25, D.C.

S. Arend of the Royal Observatory of Belgium has discovered a minor planet that he has named "**Brunonia**" in honor of Brown University. The name was selected in recognition of the fact that the 190-yr-old Brown was one of the first institutions in America to teach astronomy. It is also a tribute by Dr. Arend to the internationally known research of Charles H. Smiley, chairman of the Brown Astronomy Department.

In a recent issue of *Frontiers*, journal of the Academy of Natural Sciences of Philadelphia, Dan Brogan describes how **beavers** are taken from regions overpopulated with the animals and parachuted from planes into inaccessible areas. There it is hoped that they will build many dams. Water storage reservoirs thus built in the mountains aid inhabited territories below.

A new electronic instrument, the **Physiological Monitor**, that automatically detects changes in the physiological condition of a patient on the operating table has been developed at the National Bureau of Standards by Saul R. Gilford and Herbert P. Broida. Financial support for the project was provided by the Veterans Administration and by the NBS Office of Basic Instrumentation, which is sponsored by the Office of Naval Research, the Office of Air Research, and the Atomic Energy Commission. The instrument measures changes in the patient's blood pressure, heart beat, and respiration as they occur, and indicates this information on a panel for interpretation by the surgeon or anesthesiologist. A permanent record of the patient's condition during the operation also is provided.

The new device will not only be of great value to surgery, but may also be useful for certain physiological and medical research problems. Preliminary trials have been made at Mount Alto, VA hospital in Washington, and also at George Washington University Hospital, where the present model will be employed by Charles Coakley for further study.

The Fish and Wildlife Service has a new research vessel for use in studying ocean conditions associated with red tides, a marine plague, caused by *Gymnodinium brevis* that kills millions of fish in west coast Florida waters and also is responsible for certain respiratory irritations in humans.

Scientists in the News

Henry L. Barnett has been named professor and chairman of pediatrics at the Albert Einstein College of Medicine of Yeshiva University. Dr. Barnett, who is associate professor of pediatrics at Cornell University Medical College and associate attending pediatrician at New York Hospital-Cornell Medical Center, will also serve as director of pediatrics at the new Bronx Municipal Hospital Center.

Hans H. Bleich, professor of civil engineering at Columbia University, has been appointed technical director of the Institute of Air Flight Structures. The Institute was established at Columbia on Jan. 1 with a grant from the Daniel and Florence Guggenheim Foundation. Grover Loening, aviation industrialist, is chairman of the Institute's advisory council. Appointed to assist Dr. Bleich are **Alfred M. Freudenthal**, **Bruno A. Boley**, and **Lee Arnold**, all of the Department of Civil Engineering.

Charles Van Buskirk, assistant professor of neurology at the University of Minnesota Medical School, has been appointed professor of neurology and head of the division of neurology at the University of Maryland, effective in July.

P. A. M. Dirac, winner of the 1933 Nobel Prize in physics and Lucasian Professor of Mathematics at Cambridge University, England, since 1932, has been

denied a visa. Dr. Dirac was to serve this fall as visiting professor in theoretical physics at the Institute for Advanced Study, as he has done several times before in the last 10 yr. He was also to have spoken at Columbia University's bicentennial celebration.

The 1954 Carl-Engler-Medaille, Germany's highest award in the field of mineral oil science, will be awarded to **Gustav Egloff**, director of research for Universal Oil Products Company, Des Plaines, Ill. Dr. Egloff, who is the first scientist living outside of Germany to be selected, will receive the medal in October during the annual congress of the German Institute of Petroleum and Coal to be held in Essen, West Germany. He will give an address on "Chemistry in the modern oil industry." Following the meeting, Dr. Egloff will study the latest advances in Germany's chemical fields and will also give a series of lectures at West German universities and technical schools.

Edgar E. Foster, consulting engineer formerly of the U.S. Bureau of Reclamation, has announced the opening of an office in Denver, Colo.

Joseph F. Foster has resigned at Iowa State College to join the faculty of the Department of Chemistry at Purdue University, effective July 1.

Robert M. Garrels of the U.S. Geological Survey has been appointed associate professor of geology at Harvard University, effective July 1.

Bentley Glass, Johns Hopkins University, was elected chairman of the Governing Board of the American Institute of Biological Sciences, 1954-55, at the annual meeting held on May 14 in Washington, D.C. Also elected to office at that time were **Wallace O. Fenn** of the University of Rochester School of Medicine, who will serve as vice-chairman of the Governing Board, and **A. C. Smith** of the Smithsonian Institution, who was made a member of the Executive Committee.

Hidden T. Cox, deputy executive director of the A.I.B.S. during the past year, will return in September to the Virginia Polytechnic Institute, where he is professor of botany.

Harry E. Goresline, chief of the Stability Division of the Quartermaster Food and Container Institute for the Armed Forces, Chicago, has been appointed to the newly created post of associate director for research of the Food Laboratories.

At a meeting in the New York Academy of Medicine arranged by the Memorial Center for Cancer and Allied Diseases, **Lewis L. Strauss**, chairman of the Atomic Energy Commission, presided at the presentation of four awards given in memory of Katherine Berkan Judd, who left part of her estate to Memorial Center for recognition of achievements in cancer research. The recipients are selected by the Sloan-Kettering Division of Cornell University Medical College.

Those honored were **Evarts A. Graham** of the Wash-

ington University School of Medicine, St. Louis; **George Otto Gey** of Johns Hopkins School of Medicine; **L. H. Gray** of Mount Vernon Hospital, Northwood, Middlesex, England; and **Sidney Farber** of the Harvard Medical School.

At a meeting of the board of directors of Mead Johnson and Co., **Ben King Harned**, executive director of research, was named vice president for research.

John Happel, professor of chemical engineering and chairman of the department at New York University, was honored recently at a meeting of the American Chemical Society's New York Section. He received the Industrial and Engineering Chemistry Honor Scroll that is presented annually by the Society's Division of Industrial and Engineering Chemistry to recognize the reporting of sound scientific work in a clear, interesting manner.

On July 1, **Leonard James** of New Zealand will join the pediatric staff of the State University of New York to work on the physiology of the newborn infant's first breath. New ways of resuscitating newborn babies will be tested. This is a combined study in the Departments of Obstetrics, Pathology, and Pediatrics and will be supported by United Cerebral Palsy.

Donald F. Jones, chief geneticist at the Connecticut Agricultural Experiment Station in New Haven, has received the 1954 award of the New York Farmers, presented annually for outstanding contributions to the field of agronomy. The award, a medal and a check for \$500, was made to Dr. Jones for his development of pollen-sterile corn strains used in making superior double-cross hybrid varieties.

Thomas D. Nicholson, assistant professor of navigation and astronomy and director of the planetarium at the U.S. Merchant Marine Academy, Kings Point, has been appointed associate astronomer of the American Museum-Hayden Planetarium.

John R. Sampey, professor of chemistry at Furman University has received the 1954 Herty Medal, which is sponsored by the Chemistry Club of the Georgia State College for Women, for his contributions to chemistry in the South. He was chosen for this honor by the Georgia Section of the American Chemical Society.

George Scatchard, professor of physical chemistry at the Massachusetts Institute of Technology, has been awarded the 1954 Theodore William Richards Medal of the American Chemical Society's Northeastern Section.

Harold Schlosberg of Brown University is the new chairman of the Society of Experimental Psychologists.

Homer W. Smith, professor and chairman of the Department of Physiology, New York University College of Medicine, has been selected as the recipient of

the \$5000 Passano Foundation Award for his many contributions over the last 20 yr to the knowledge of the physiology of the kidney. Presentation will take place on June 21 during the American Medical Association convention in San Francisco.

The Secretariat of the International Academy of the History of Pharmacy in Rotterdam has informed the University of Wisconsin of the election to membership of **Glenn Sonnedecker** of the University School of Pharmacy.

Harlan L. Tuthill, formerly plant technical director for Smith, Kline & French Laboratories, Philadelphia, has been named scientific director for two foreign subsidiaries, SK&F Inter-American Corp. and SK&F International Co. **Carl H. Cunov**, assistant plant technical director, succeeds Dr. Tuthill as technical director.

George Urdang, professor emeritus of the history of pharmacy at the University of Wisconsin, has been elected honorary member of the new Brazilian Society for the History of Pharmacy.

Frank H. Westheimer, recently appointed professor of chemistry at Harvard University, has been named the 1954 Harrison Howe lecturer of the Rochester Section of the American Chemical Society. The formal award of this honor and the delivery of the lecture will take place on Nov. 13. The emphasis of Dr. Westheimer's work has been in both physical and organic chemistry. He has made valuable contributions relating to the mechanisms of organic reactions, including aromatic nitration and mercuriation and, the chromic acid oxidation of alcohols. Recently he has given attention to reactions of biochemical interest.

Education

The Cooper Union School of Engineering will consolidate the work of the departments of mechanical engineering and machine design and engineering drawing into a single department, effective next semester. **Kenneth E. Lofgren**, formerly associate professor, has been appointed professor of machine design and given responsibility for the machine design and engineering drawing section of the Mechanical Engineering Department, which will continue under the chairmanship of **William A. Vopat**. **C. Higbie Young**, professor and chairman of the machine design department for 18 yr, will retire on June 30.

A new approach to the old question "What is man?" will be attempted at **Cornell University**, beginning next year, in a trilogy of courses in zoology, psychology, and sociology. The series of three one-semester courses on "The nature of man" will investigate the physical, psychological, and social aspects of human beings in a number of societies. Faculty members and students together will seek a compromise between two extreme views—that the individual is complete master

of his fate, and that his fate is determined largely by heredity and social environment.

The first course, in the zoology department, deals with human structure and function; it is designed for nonbiology students and will focus on the human body, using animals only occasionally for illustration. The second is a psychology course on "Personality and culture." The third is a sociology and anthropology course on "Culture and personality."

A new graduate program leading to the M.S. degree in pharmacy has been approved at **Drake University**, Des Moines, Iowa. It will be open to graduates of 4-yr colleges who have majored in pharmacy or some other scientific field.

A \$5000 annual fund has been established at **Illinois Institute of Technology** by the Industrial Filter and Pump Manufacturing Co. of Chicago to assist liberal arts students in acquiring an engineering education. In establishing the fund, named in honor of Tom Lundberg of Coloma, Wis., founder and president of the company, the need for engineers with well-rounded educational backgrounds was stressed.

The **Hoffberger Science Hall** at **Goucher College** was recently dedicated. The building cost more than \$1,000,000 and was built largely with a gift from the Hoffberger Foundation, established by a family of Baltimore industrialists and financiers. The new three-story stone structure completes the move of Goucher College from Baltimore city to its new campus on the outskirts.

The **Hope College** physics department is building a cyclotron as a student project and for use by all science classes. The Ciba Co. has provided the combined science departments of the college with a grant for the purpose of financing, in part, the costly work. When completed the Hope equipment will have a one-half ton magnet wound with 400 turns of $\frac{1}{4}$ in. copper tubing. It will be capable of an output of 1.6 Mev.

A joint 5-yr liberal arts-engineering curriculum will be initiated at the University Heights center of New York University beginning with the fall semester.

Reed College has entered a cooperative "3-2 plan" with the California Institute of Technology to bring the number of liberal arts colleges cooperating with Caltech to four. The plan provides that recommended engineering students from these colleges will be admitted to Caltech as juniors after 3 yr of study on a prearranged program. After the student successfully completes 2 yr at Caltech, he will be awarded the B.A. degree by the college and the B.S. degree by Caltech.

The **Rutgers Research and Endowment Foundation** has established the **Waksman Foundation** for Microbiology and Medical Research in Japan, named after **Selman A. Waksman**, the Rutgers scientist who, with associates, discovered streptomycin. The Japanese foundation will be financed in part with royalties from

the manufacture of streptomycin in Japan, where a patent on the drug is pending.

The Foundation also will license the manufacture of dihydrostreptomycin. Royalties on net sales of the two drugs will be divided evenly between the **Waksman Foundation** in Japan and the **Rutgers Institute of Microbiology**.

The **University of Tennessee Medical Units'** new \$1,373,354 Chemistry-Physiology Building is scheduled to be partially completed by Sept. 15 and fully completed by Oct. 27. The building is one of three under construction in a \$5,000,000 expansion program; the other two are an Administration-Postgraduate Building and a Medical-Surgical Building.

Grants and Fellowships

American Cyanamid Co. has established an undergraduate scholarship program in chemistry and chemical engineering to supplement its existing graduate fellowships and grants. Under the new program, 17 undergraduates about to enter their junior or senior year will be awarded \$600 each for the academic year 1954-55. In addition, each scholarship college will receive \$300 for the unrestricted use of its chemistry or chemical engineering department.

Under the fellowship program, 15 students in their final predoctoral year of study receive \$1500 in addition to full tuition and laboratory fees; their department of chemistry or chemical engineering receives \$300 for unrestricted use. Appointments under the two programs are made by the university or college.

The **Gravity Research Foundation**, New Boston, N.H., is for the 6th year offering five awards for essays on gravity. These awards will be made on Dec. 1 for the best 1500 word essays on the possibilities of discovering: (i) some partial insulator, reflector, or absorber of gravity, or (ii) some alloy or other substance, the atoms of which can be agitated or rearranged by gravity to throw off heat, or (iii) some other reasonable method of harnessing gravitational energy. In none of these proposals can outside energy be used.

The awards will be for \$1000, \$300, \$200, \$150, and \$100 respectively. Essays must be submitted before Oct. 15. They will be accepted from anyone who is seriously interested in the application of gravity to practical uses for the benefit of humanity. For details, write to the Foundation.

The **Paint, Plastics, and Printing Ink Division** of the **American Chemical Society** has established a **Carbide and Carbon Chemicals Award**. It will be financed from royalties accruing from the sale of a book to be published this fall, *Technology of Solvents and Plasticizers*, by **Arthur K. Doolittle**, past chairman of the division and assistant director of research for the Carbide and Carbon Chemicals Company. The Company will supplement the royalties in the initial year, if necessary, so that in no year will the amount of the prize be less than \$300.

The award will be given annually for the outstanding scientific contribution reported in a technical paper before a regular meeting of the division. The first winner will be announced in June 1955, and the prize will be presented at the 128th national meeting of the American Chemical Society in Minneapolis in September. Thereafter, the award will be made at each fall meeting of the society on the basis of papers presented at the two previous meetings. Information on deadlines and instructions for preparing papers for the preprint booklet may be obtained from Dr. A. L. Alexander, Naval Research Laboratory, Washington 25, D.C.

Fellowships designed to prepare men for academic careers in medicine, principally in the field of pathology, have been established by the Department of Pathology of the University of Pittsburgh. They will provide 3 yr of experience in research, teaching, and diagnostic pathology at the university; then arrangements will be made for 1 yr of work at another medical center of the applicant's choice.

One fellow will be appointed each year for a 4-yr term and will receive a stipend increasing from year to year as follows: \$3000; \$3300; \$3700; \$4000. The applicant must be a graduate of an approved medical school. *Application must be made by Nov. 1* for a fellowship beginning July 1. For further information address Dr. Frank J. Dixon, Department of Pathology, University of Pittsburgh, Pittsburgh 13.

The National Science Foundation has announced 159 grants, totaling approximately \$1,359,000 for basic research in the natural sciences and to support studies and conferences on science, scientific information exchange, compilation of scientific personnel information, education in the sciences, and travel to international meetings. This is the third group of awards to be made during fiscal year 1954 for the support of basic research and related matters.

Harvard University. M. W. Mayall. Light variations of more than 500 variable stars, 1 yr, \$10,000.

University of Florida. D. Duke. Dept. of Astronomy. Photographic studies of close binaries, 1 yr, \$1200.

Harvard University. B. J. Bok and H. I. Ewen. Harvard Observatory. Radio astronomy in the microwave region, 1 yr, \$17,000.

Louisiana State University. K. Yoss. Dept. of Physics and Astronomy. Relative frequencies of galactic star populations, 2 yr, \$2700.

University of Michigan. L. H. Aller. Dept. of Astronomy. Abundances of light metals in stars and nebulae, 2 yr, \$11,000. Mount Holyoke College. A. H. Farnsworth. Dept. of Astronomy. Milky way field, 3 yr, \$1500.

Ohio State University. P. C. Keenan. Dept. of Physics and Astronomy. Spectroscopic study of luminosity and composition of S-type and related stars, 2 yr, \$3700.

Princeton University. M. Schwarzschild. Dept. of Astronomy. Advanced stages of stellar evolution, 2 yr, \$12,600.

Brandeis University. S. G. Cohen. Dept. of Chemistry. Chemistry of free radicals, 3 yr, \$18,000.

University of California. R. L. Scott. Dept. of Chemistry. Molecular complexes involving halogens, 3 yr, \$14,800.

Carnegie Institute of Technology. R. A. Glenn. Dept. of Chemistry. Chemical nature of coal hydrogenation products, 3 yr, \$12,000.

University of Colorado. R. N. Keller. Dept. of Chemistry. Low count-rate techniques in radiocarbon dating, 2 yr, \$10,000.

University of Florida. G. A. Greathouse. Engineering and Industrial Experiment Station. Mechanism of synthesis and degradation of specifically labeled C^{14} cellulose, 2 yr, \$6500.

Howard University. M. D. Taylor. Dept. of Chemistry. Ac-

tion of simple and complex hydrides on rare earth compounds, 2 yr, \$12,000.

Illinois Institute of Technology. S. E. Wood. Dept. of Chemistry. Properties of nonelectrolytic solutions, 3 yr, \$24,000.

University of Illinois. H. A. Laitinen. Dept. of Chemistry and Chemical Engineering. Adsorption processes at electrode surfaces, 2 yr, \$11,800.

University of Illinois. H. R. Snyder. Dept. of Chemistry. Alkaloids of haplophyton cnicoides, 3 yr, \$29,600.

University of Louisville. J. P. Phillips. Dept. of Chemistry. Analytical reagents related to 8-quinolinol, 2 yr, \$5100.

University of Maryland. G. Brown. Dept. of Chemistry. X-ray analysis of organic crystal structures, 2 yr, \$10,400.

University of Notre Dame. C. Curran. Dept. of Chemistry. Localized and nonlocalized hydrogen bonding, 2 yr, \$6100.

Ohio State University. M. L. Wolfson. Dept. of Chemistry. Determination of polysaccharide structure by degradative methods, 3 yr, \$25,000.

Rensselaer Polytechnic Institute. S. Ross. Dept. of Chemistry. Two-dimensional condensation of adsorbed vapors on solid surfaces, 1 yr, \$5000.

University of Utah. R. E. Hamm. Dept. of Chemistry. Solution chemistry of complex ions, 2 yr, \$9700.

Western Reserve University. E. L. Pace. Dept. of Chemistry. Thermodynamics and molecular structure of simple fluorine compounds, 2 yr, \$10,500.

University of Wisconsin. W. S. Johnson. Dept. of Chemistry. Synthesis of structures related to the steroids, 2 yr, \$15,000.

Florida State University. C. B. Metz. Dept. of Zoology. Nature and role of specific substances in fertilizin, 2 yr, \$8100.

University of Wisconsin. H. W. Mossman. Dept. of Anatomy. Uterine vascular system in the hamster, 1 yr, \$4370.

University of Wisconsin. K. B. Raper. Dept. of Botany. Speciation in simple slime molds, 3 yr, \$18,900.

American Museum of Natural History. N. Y. N. D. Newell. curator of historical geology and fossil invertebrates. Phylogenetic studies of Pelecypoda, 1 yr, \$3100.

University of California. D. I. Axelrod. Dept. of Geology. Pliocene floras of western Nevada, 3 yr, \$13,800.

University of California. C. Meyer. Dept. of Geological Sciences. Hydrothermal alteration studies of micas, mica-like clays and related minerals, 2 yr, \$19,500.

University of California. G. Tunell. Dept. of Geology. Geochemistry of mercury ores, 2 yr, \$17,700.

Columbia University. D. B. Ericson. Lamont Geological Observatory. Lithological and micropaleontological investigation of Atlantic ocean sediment cores, 2 yr, \$18,000.

North Dakota Agricultural College. P. Tasch. Dept. of Geology. Fauna and paleoecology of the depauperate zone of the maguoketa shale of Iowa, 1 yr, \$1000.

Oberlin College. P. B. Sears. K. Clishy and F. Foreman. Continuous history of vegetation, climate and sediments extending into the Pleistocene, 1 yr, \$9000.

Pennsylvania State University. B. F. Howell, Jr. Dept. of Earth Sciences. Formation of seismic pulses, 2 yr, \$12,100.

Princeton University. J. C. Maxwell. Dept. of Geology. Compaction and cementation of sediments, 2 yr, \$10,800.

University of Utah. E. Roedder. Dept. of Mineralogy. Phase equilibrium relations in the system $K_2O-FeO-Al_2O_3-SiO_2$, 2 yr, \$13,400.

Carnegie Institute of Technology. C. L. McCabe. Dept. of Metallurgical Engineering. Determination of activity of silicon in liquid silicate systems, 18 mo, \$11,000.

Case Institute of Technology. W. L. Bryan. Mechanical Engineering Dept. Heat transfer to boiling liquids flowing in horizontal tubes, 1 yr, \$5700.

Colorado Agricultural and Mechanical College. M. L. Albertson. Dept. of Civil Engineering. Resistance to flow in open channels, 30 mo, \$12,500.

University of Illinois. J. W. Westwater. Div. of Chemical Engineering. Metastable boiling, 2 yr, \$13,500.

State University of Iowa. J. O. Osburn. Div. of Chemical Engineering. Supersaturation in liquid solutions, 1 yr, \$8000.

Johns Hopkins University. H. E. Hoelscher. Dept. of Chemical Engineering. Kinetics of reactions in three-phase systems, 2 yr, \$9000.

Kansas State College. D. R. Carver. Applied Mechanics Dept. Stability of rings and circular arches under arbitrary loading, 2 yr, \$10,000.

Lehigh University. L. S. Beedle. Dept. of Civil Engineering. Influence of residual stress on column strength, 3 yr, \$15,000.

Massachusetts Institute of Technology. M. C. Shaw. Dept. of Mechanical Engineering. Stress and energy characteristics of brittle materials during comminution, 1 yr, \$6000.

Montana School of Mines. D. W. McGlashan. Dept. of Mining Engineering. Effects of progressive change of position on the surface reactivity of aliphatic derivatives, 2 yr, \$13,000.

New York University. R. E. Treybal. Dept. of Chemical En-

gineering. Mass transfer to and from solid spheres immersed in a flowing fluid, 30 mo, \$7000.

University of North Dakota. W. R. Kube, Dept. of Chemical Engineering. Sorption of water vapor by thermally treated lignite, 18 mo, \$3400.

Northwestern University. G. Thodos, Dept. of Chemical Engineering. Vapor liquid equilibrium studies in multicomponent systems, 2 yr, \$10,000.

Ohio State University. J. D. Kraus, Dept. of Electrical Engineering. Positions and characteristics of discrete radio sources, 2 yr, \$9800.

University of Pennsylvania. F. J. Dunkerley, Dept. of Metallurgical Engineering. Thermodynamic properties of sulphur and oxygen in liquid iron alloys, 2 yr, \$20,000.

Purdue University. E. W. Comings, School of Chemical and Metallurgical Engineering. Properties of gases at high pressures, 2 yr, \$14,000.

University of Utah. J. H. Hamilton and J. R. Lewis, Dept. of Metallurgical Engineering. Kinetics of the removal of carbon from molten metal-carbon mixtures by reaction with carbon dioxide, 3 yr, \$13,000.

Vassar College. G. E. Baker, Plant Science Dept. Microorganisms in lake water, 3 yr, \$5300.

Harvard University. J. R. Raper, botany. Naturally occurring filtrable mutagens in *Schizophyllum*, 1 yr, \$5500.

Missouri Botanical Garden. E. Anderson, Genetics. Introgression in natural populations, 3 yr, \$19,000.

University of North Carolina. D. U. Gerstel, Dept. of Agronomy. Segregation in artificial amphidiploids in genus *Gossypium*, 3 yr, \$12,500.

Purdue University. D. C. Warren and A. E. Bell, Dept. of Poultry Husbandry. Heterosis in *Drosophila melanogaster*, 3 yr, \$18,400.

American Mathematical Society. Summer mathematical institute for the study of functions of several complex variables, \$25,000.

Brown University. B. Jonsson, Dept. of Mathematics. Problems in modular lattices, 1 yr, \$3400.

Queens College. L. Zippin, Dept. of Mathematics. Topological groups acting as transformation groups, 1 yr, \$7700.

University of Washington. E. Hewitt, Dept. of Mathematics. Investigations in functional analysis, 21 mo, \$30,000.

University of Pennsylvania. S. D. Rodenberg, Laboratory of Microbiology. Biosynthesis of proteins associated with microbial cells, 2 yr, \$2200.

University of Alabama. A. E. Ruark, Dept. of Physics. Cloud chamber search for free magnetic poles, 3 yr, \$14,300.

Antioch College. A. B. Stewart and G. E. Owen, Dept. of Physics. Glow discharge oscillations, 2 yr, \$10,000.

Brigham Young University. H. Fletcher, Dept. of Physics. Definitive physical characteristics of tones, 2 yr, \$11,100.

Bryn Mawr College. J. R. Pruett, Dept. of Physics. Direction correlations and forbidden beta-spectra, 2 yr, \$8000.

University of Chicago. M. G. Inghram, Dept. of Physics. Mass spectrometric investigations, 2 yr, \$20,000.

University of Colorado. W. A. Rense, Dept. of Physics. Polarization measurements of the zodiacal light during total solar eclipse of June 1954, 6 mo, \$1700.

Columbia University. H. M. Foley, Dept. of Physics. Theory of nuclear quadrupole effects, 18 mo, \$11,300.

Cornell University. R. L. Sproull, Dept. of Physics. Thermal conductivity and crystal imperfections, 3 yr, \$15,000.

Johns Hopkins University. H. Meisner, Dept. of Physics. Intermediate state of superconductivity, 2 yr, \$6000.

Louisiana State University. J. S. Levinger, Dept. of Physics. Theory of photonic nuclear reactions, 2 yr, \$8700.

University of Maryland. S. F. Singer. Origin of ultrahigh-energy cosmic rays, 2 yr, \$15,500.

University of Michigan. D. A. Glaser, Dept. of Physics. Use of bubble chambers in the study of high-energy nuclear interactions, 2 yr, \$12,600.

University of Minnesota. A. O. C. Nier, Dept. of Physics. Atomic mass determinations, 2 yr, \$15,500.

University of North Carolina. J. W. Straley, Dept. of Physics. Intensities of infra-red absorption bands, 3 yr, \$11,700.

Northwestern University. J. A. Marcus, Dept. of Physics. Hall effect in single crystals at low temperatures, 2 yr, \$11,100.

Ohio State University. J. G. Daunt and P. S. Jastram, Dept. of Physics. Nuclear orientation at low temperatures, 2 yr, \$17,000.

Reed College. F. C. Brown, Dept. of Physics. Conduction and trapping in ionic crystals, 2 yr, \$8500.

Wisconsin Alumni Research Foundation. D. W. Kerst, Dept. of Physics. University of Illinois. High-energy accelerator problems, 6 mo, \$21,800.

Yale University. H. Margenau, Dept. of Physics. Definition and law in the physical sciences, 2 yr, \$4600.

Princeton University. H. Gulliksen, Dept. of Psychology. Mathematical techniques in psychology, 3 yr, \$24,400.

University of Washington. A. F. Ax, Dept. of Psychiatry. Investigations of human reactions to stress, 3 yr, \$17,200.

Princeton University. W. W. Swingle, Dept. of Biology. The isolation, physiological properties and bioassay of the amorphous fraction of adrenal cortical extracts, 2 yr, \$11,500.

Bernice P. Bishop Museum, Honolulu. J. L. Gressitt. Insects of Micronesia, 3 yr, \$30,000.

University of Hawaii. D. E. Hardy, Dept. of Entomology. Diptera of Hawaii, 1 yr, \$2000.

University of North Carolina. J. N. Couch, Dept. of Botany. Genus *actinoplanes*, 3 yr, \$15,300.

U.S. Geological Survey. P. E. Cloud, Jr., Paleontology and Stratigraphy Branch. Marine mollusks of reefs of the Pacific ocean, 1 yr, \$3000.

Woods Hole Oceanographic Institution. G. L. Clarke, marine biologist. Penetration of light into the sea and its effect on aquatic organisms, 1 yr, \$6200.

Woods Hole Oceanographic Institution. J. H. Ryther. Basic biological productivity of offshore waters, 3 yr, \$6700.

American Type Culture Collection. F. Weiss, curator. Collection of bacteriophages (bacterial viruses), 2 yr, \$11,000.

Bermuda Biological Station for Research, Inc. Biological research, 5 yr, \$10,000.

Duke University. Biological research at its Marine Laboratory, 3 yr, \$12,000.

University of Georgia. P. R. Burkholder, Dept. of Bacteriology. Development of national culture collection of algae, 2 yr, \$7500.

University of Minnesota. Biological research at the Itasca Biological Station, 1 yr, \$3000.

National Academy of Sciences. Operating expenses of Pacific Science Board, 3 yr, \$39,000.

National Academy of Sciences. U.S. National Committee for the International Geophysical Year 1957-58, \$22,000.

Sierra Club, San Francisco. California Himalayan expedition committee, 1 yr, \$5000.

Attendance at international meetings

Third General Assembly and Congress of International Union of Crystallography. N. C. Baensiger, Dept. of Chemistry, State University of Iowa; J. D. H. Donnay, Crystallographic Laboratory, Johns Hopkins University; I. Fankuchen, Dept. of Physics, Polytechnic Institute of Brooklyn; W. H. Zachariasen, Dept. of Physics, University of Chicago; B. E. Warren, Dept. of Physics, Massachusetts Institute of Technology, \$2000.

Faraday Society, Discussions on Fast Reactions. I. M. Kolthoff, Dept. of Chemistry, University of Minnesota; R. G. Pearson, Dept. of Chemistry, Northwestern University, \$1000.

Second General Assembly of International Mathematical Union. S. MacLane, Dept. of Mathematics, University of Chicago; E. Hille, Dept. of Mathematics, Yale University, \$1210.

International Congress of Mathematicians. L. Zippin, Dept. of Mathematics, Queens College, N.Y.; A. Tarski, Dept. of Mathematics, University of California; R. L. Wilder, Dept. of Mathematics, University of Michigan; G. T. Whyburn, Dept. of Mathematics, University of Virginia; E. E. Moise, Dept. of Mathematics, University of Michigan; L. Henkin, Dept. of Mathematics, University of California; P. L. Halmos, Dept. of Mathematics, University of Chicago; A. Erdelyi, Dept. of Mathematics, California Institute of Technology; R. Brauer, Dept. of Mathematics, Harvard University; A. A. Albert, Dept. of Mathematics, University of Chicago, \$5000.

Fourth International Conference on Electrode-position and metal finishing. W. Blum, Washington, D.C., \$500.

Eleventh General Assembly of International Scientific Radio Union. S. Silver, Dept. of Electrical Engineering, University of California; E. C. Jordan, Dept. of Electrical Engineering, University of Illinois; D. F. Tuttle, Dept. of Electrical Engineering, Stanford University; J. M. Pettit, Electronics Research Laboratory, Stanford University; W. G. Shepherd, Dept. of Electrical Engineering, University of Minnesota; A. W. Sullivan, Engineering and Industrial Experiment Station, University of Florida; H. I. Ewen, Harvard College Observatory; V. H. Ramsey, Director, Antenna Laboratory, Ohio State University, \$2910.

World Power Conference. G. O. G. Lof, consulting chemical engineer, Denver, Colorado; W. A. Lewis, Illinois Institute of Technology, \$1500.

Symposium on Comparative Endocrinology of Vertebrates. W. R. Breneman, Dept. of Zoology, Indiana University; E. W. Dempsey, Dept. of Anatomy, Washington University; A. Gorbman, Dept. of Zoology, Barnard College, Columbia University; R. O. Greep, Dept. of Biology, Harvard School of Dental Medicine; F. L. Hisaw, Biological Laboratories, Harvard University; F. G. Hoffman, Dept. of Pharmacology,

Columbia University; J. H. Leatham, Dept. of Zoology, Rutgers University; W. H. Sawyer, Dept. of Physiology, New York University; E. Witschi, Dept. of Zoology, State University of Iowa. \$4550.

Eighth General Assembly of International Union of Pure and Applied Physics. J. A. Wheeler, Dept. of Physics, Princeton University; R. Smoluchowski, Dept. of Physics, Carnegie Institute of Technology; L. Marton, Electron Physics Section, National Bureau of Standards. \$1600.

Policy Board of the International Union of Biological Sciences. P. Weiss, Division of Biology and Agriculture, National Research Council. \$1000.

Conferences in support of science

American Psychological Association. 14th International Congress of Psychology, \$10,000.

University of California. Significance and possibilities of high-speed computing in meteorology, \$6000.

Indiana University. Stellar atmospheres, \$3300.

Long Island Biological Association. Mammalian fetus—physiological aspects of development, \$6500.

University of Michigan. Multidimensional analysis, \$5300.

Swarthmore College. Astronomy research in colleges, \$5000.

Education in the sciences

University of California. Summer conference for teachers of astronomy, 4 wk, \$8750.

Columbia University. Conference on nuclear physics in engineering education, 10 da, \$8200.

University of Illinois. Conference on solid state physics in engineering education, 10 da, \$7000.

Mathematical Association of America. University of Buffalo. Support of program for visiting scientists, 1 yr, \$15,000.

Washington and Lee University. Conference on undergraduate research in chemistry, 3 da, \$5700.

Scientific information exchange

American Mathematical Society. Preparation and distribution of selected translations of Russian mathematics articles, 1 yr, \$14,500.

Library of Congress. Compilation of lists of scientific and technical serial publications, 6 mo, \$6500.

Scientific manpower

American Mathematical Society. Register of scientific and technical personnel in field of mathematical sciences, 1 yr, \$13,800.

American Psychological Association. Register of scientific and technical personnel in field of psychology, 1 yr, \$11,600.

The Pharmaceutical Foundation, University of Texas, has announced the renewal of an annual grant of \$20,000 from the Benjamin Clayton Foundation for Research. Directors of the project are Henry M. Burlage of the College of Pharmacy and Alfred Taylor of the Biochemical Institute.

Meetings and Elections

The Cook Inlet Branch of the Alaska Division of AAAS has elected these officers: pres., Arthur L. Jess, Corps of Engineers, U.S. Army; v. pres., Frank P. Pauls, Alaska Dept. of Health; sec.-treas., Andy J. Zeberl, Alaska Dept. of Health.

The American Academy of Arts and Sciences has elected the following officers: pres., John E. Burchard; sec., William C. Greene; treas., Horace S. Ford. Vice presidents are Edward L. Bowles, James M. Faulkner, Erwin D. Canham, and Robert Ulich.

The annual meeting of the British Association for the Advancement of Science will be held in Oxford Sept. 1-8. The following information, taken from the current preliminary program, is of interest.

The British Association was founded in 1831 and is the oldest body of its kind in the world. There are

16 similar Associations in other countries, all modeled directly or indirectly on the British Association. Simply expressed the objects of the Association are: (i) to encourage and direct scientific enquiry; (ii) to promote contacts between scientists at home and abroad; (iii) to obtain general attention for the objects of science; (iv) to work for the removal of any public disadvantages that hinder the progress of science. These objects are achieved by means of meetings, conferences, lectures, collaboration with other scientific organizations, research, and publication.

The chief activity of the Association, and that on which its reputation has been mainly based, is its great annual meeting which has been held without a break, except during the two world wars, in various cities in Great Britain and in other parts of the Commonwealth. On no other occasion do so many scientists, from all branches, academic and applied, meet together to discuss problems of current interest. The membership includes leaders in all branches of science and technology at home and abroad; it also includes many who are not scientists because membership is open to all, with or without scientific qualifications. The average attendance at six postwar meetings has been about 3700.

The annual meeting has been described at different times as the Parliament of Science, as a peripatetic university bringing science into the market place and, less seriously, as a 13-ring circus. Now that research is so largely supported directly and indirectly from public funds, these meetings have assumed new importance as one of the main occasions when scientists report progress to the public.

New officers of the Colorado-Wyoming Academy of Science are: pres., Hugo G. Rodeck, University of Colorado, Boulder; v. pres., Fred L. Herman, Colorado State College, Greeley; exec. sec., O. Wilford Olsen, Colorado A and M College, Fort Collins; treas., Fred Freytag, University of Wyoming, Laramie. Frank E. E. Germann of the University of Colorado is the representative to the AAAAS Council.

Alan T. Waterman, director of the National Science Foundation, is chairman of the 4th Conference of the Association of Princeton Graduate Alumni to be held at Princeton University, June 16-17. The conference theme is "Horizons in scholarship," and the following speakers—all of Princeton—are among those included on the program: Lyman Spitzer, Jr., director of the Observatory, and Charles A. Young, professor of astronomy; John von Neumann, professor of mathematics at the Institute for Advanced Study; and Edward C. Kendall, visiting professor of chemistry in the Forrestal Research Center.

The New York Academy of Sciences recently held a 3-day conference on the functions of the leukocytes under the cochairmanship of Albert S. Gordon of New York University, John W. Rebeck of Henry Ford Hospital, Detroit, and Robert S. Speirs of the Roscoe B. Jackson Memorial Laboratory. There were 35 par-

ticipants, among them J. M. Yoffey, University of Bristol, England; O. A. Trowell, Harwell Laboratories, England; and Paulo Seabra of the National Academy of Medicine, Brazil. The conference was dedicated to Hal Downey of the University of Minnesota Medical School, an outstanding hematologist and teacher, and represented the first comprehensive review of leukocytic functions since the publication in 1938 of his *Handbook of Hematology*.

The Department of Journalism at the University of Michigan has organized an **International Mass Communications Conference on Nuclear Energy** in Ann Arbor, June 19-24. The Conference will include discussions of the social, technological, and political implications of nuclear energy in the fields of power, medicine, food, and chemical products.

Recognizing the urgency for closer cooperation between scientists, writers, editors, and other mass communicators, the **International Nuclear Engineering Congress**, which convenes in Ann Arbor at about the same time, June 20-25, will have concurrent sessions with the conference on communications. These sessions and some social activities should do much to develop mutual appreciation by scientists, writers and editors of their respective roles in the new nuclear culture. Scientists from the U.S. and from 11 foreign countries will participate in the concurrent sessions. For further information write Wesley H. Maurer, Chairman, Department of Journalism, University of Michigan.

An international symposium on temperature, its concept and measurement, will be held in Washington, D.C., Oct. 28-30, under the joint sponsorship of the American Institute of Physics, the National Bureau of Standards, and the Office of Ordnance Research (U.S. Army). The program will include fundamental discussions of the temperature concept in relation to such unusual systems as very hot gases and matter near absolute zero, as well as methods of measuring these extreme temperatures. Considerations will also be given to the temperature scales and standards in current use, and the effects of recent changes in the definitions of these scales.

This will be the third temperature symposium in a series that began in 1919 and was continued in 1939. The collected papers will be published in book form, as were the 1939 symposium papers. Over-all guidance of the symposium is in the hands of a committee composed of A. V. Astin (chairman), J. A. Beattie, F. G. Brickwedde, W. O. Davis, Jr., I. Estermann, K. F. Herzfeld, T. J. Killian, Paul E. Klopsteg, J. E. Mayer, Wallace Waterfall, and Alfred Weissler (secretary). Details of the program will be announced in July. For further information, address Wallace Waterfall, American Institute of Physics, 57 E. 55 St., New York 22.

The 86th annual meeting of the **Kansas Academy of Science** and the affiliated **Kansas Psychological Association** was held Apr. 29-May 1 at Fort Hays Kansas

State College. On Apr. 29 an illustrated lecture, "Capturing the color of canyon country," was delivered by M. V. Walker of the National Park Service. On Apr. 30 technical papers were presented in the various sections: botany and microbiology, 30 papers, Andrew Riegel, chairman; chemistry, 19 papers, H. S. Choguill, chairman; geology, 9 papers, L. D. Wooster, chairman; physics, 10 papers, H. A. Zinszer, chairman; psychology, 16 papers and a panel discussion, H. B. Reed, chairman; zoology, 22 papers, E. P. Martin, chairman. The chairmen were all members of the staff of Fort Hays Kansas State College. In the Junior Academy some 112 papers and 114 exhibits were presented.

A total of 389 people registered for the meetings—213 for the senior academy and 176 for the junior academy. At the banquet, President R. E. Mohler of McPherson College gave his presidential address entitled "Science for all of life." President-elect A. C. Carpenter from Ottawa, Kansas, was toastmaster.

The following officers were elected for the coming year: pres., A. C. Carpenter, Ottawa; pres.-elect, D. J. Ameal, Kansas State College, Manhattan; v. pres., H. S. Choguill, Fort Hays Kansas State College, Hays; sec., C. T. Rogerson, Kansas State College, Manhattan; treas., Standlee Dalton, Fort Hays Kansas State College. The representative to the AAAS Council is C. T. Rogerson.

The annual meeting of the **Medical Library Association** will take place June 15-18 in Washington. The general chairman is Frank B. Rogers, lieutenant colonel and director, Armed Forces Medical Library. There will be panel discussions on the international aspects of medical research, library architecture, and service to the lay public. Speakers will include E. Bruce Harvey, a wing commander of the Royal Air Force Medical Service; Verner W. Clapp, Chief Assistant Librarian of Congress, and officials of numerous Federal medical library services.

The **Metric Association** has elected the following officers: pres., J. T. Johnson, Chicago Teachers College; sec.-treas., Vincent G. Shinkle, 1916 Eye St. NW, Washington, D.C. The vice presidents are Paul H. Bolton, Theodore H. Miller, Aubrey Drury, Theodore A. Seraphin, A. E. Pradillo, and C. J. Arnold.

The **National Science Foundation** has recently sponsored the following conferences:

Mar. 29-Apr. 1 at Bryn Mawr College, the **Place of Biological Research in the Liberal Arts Colleges**, the third in a series of conferences on the contributions of scientific research to science teaching and to the training of undergraduates; at these meetings, college science teachers exchange views on how research can be effectively coordinated with teaching and carried out with limited research facilities.

Mar. 29-Apr. 1 at Pacific Grove, Calif., a **Conference on Bioluminescence** held under the auspices of the Committee on Photobiology, National Research Council.

May 6-8 at Washington and Lee University, a **Con-**

ference on Undergraduate Research in Chemistry. About 30 faculty members of representative colleges and universities discussed the value of undergraduate research in encouraging able students to choose careers in chemistry and to continue graduate training. The problem of interesting talented students in graduate work is especially important at the present time because of the acute shortage of chemists.

Some 60 physicists met at the University of Pennsylvania, May 3-4, to discuss the interaction of high-energy electromagnetic radiation with nuclei (below the meson threshold); 27 institutions were represented at this **photonuclear conference**, and there were several visitors from abroad. Of particular interest were: (1) the proposal by D. H. Wilkinson (Cambridge University); visiting professor at the University of Pennsylvania in April and May) of a single-particle-type model of the giant photonuclear resonance involving the dipole excitation of particles from the top closed shells; (2) reports from the National Bureau of Standards of the nuclear absorption experiments of H. W. Koch, and the elastic scattering experiments of E. G. Fuller and E. Hayward; (3) the account by P. Morrison (Cornell) of the considerable amount of general theory that does not utilize specific nuclear models; and the comprehensive summary of V. Weisskopf (MIT) on how interesting and fundamental problems of nuclear structure are being approached by photonuclear research.

The conference—which was opened by G. P. Harnwell, president of the University of Pennsylvania—included papers on the fine structure in photo neutron yield curves observed by L. Katz (Saskatchewan), A. S. Penfold, and B. M. Spicer (University of Illinois); on "Photo particle emission" by J. Levinger (Louisiana State University); on "Isotopic spin considerations" by V. L. Telegdi (University of Chicago); and on "Systematics of giant resonances" by J. Halpern (University of Pennsylvania).

The meeting was enlivened by considerable discussion both during the papers and in the discussion periods led by P. Axel, L. Katz, D. W. Kerst, M. Goldhaber, D. H. Wilkinson, and J. Levinger. Additional reports were made on inelastic electron scattering by D. W. Kerst (University of Illinois) and W. C. Barber (Stanford University); on photon scattering by R. Sagane (University of California) and A. Wattenberg (MIT); on photo particle emission by D. Zafarano (Iowa State), J. Rosengren (MIT), and P. C. Gugelot (Princeton University); on light nuclei photo disintegration by E. F. Shrader (Case Institute of Technology) and D. H. Wilkinson (Cambridge University); on the collective model of giant resonances by M. Ferentz (Argonne); and on the cross-section curve of the photo neutrons from carbon and copper by W. C. Barber (Stanford).

A summary of the proceedings is being prepared by Paul Yergin, Department of Physics, University of Pennsylvania, for distribution to those attending. A few additional copies may be available for others.

On Aug. 18 Stanford University will conduct its annual conference on Latin American affairs. This year's topic will be "The population problems of Latin America." Many distinguished specialists are expected to take part. Those wishing to attend should apply to Hispanic American Studies, Room 255, Stanford University, Stanford, Calif. There will be plenary sessions, and section meetings devoted to specialized topics. Preston James of Syracuse University, an expert on Latin American population problems, will spend the summer at Stanford as visiting professor of geography and will assist in the preparation of the conference.

The invitation of the Government of Mexico extended last year to the **World Health Organization** to hold its 8th annual assembly in 1955 in Mexico City has been approved by the 7th World Health Assembly's Committee on Administration, Finance and Legal Matters. Mexico has generously offered to bear all additional costs entailed in holding the Assembly away from the headquarters in Geneva, and also to extend "the necessary facilities, immunities and privileges" to all delegates, observers, members of the WHO secretariat, and generally to all persons participating in the Assembly. All previous WHO Assemblies have been held in Geneva except for one in Rome in 1949.

Miscellaneous

The first issues of the Frankfurt edition of *Zeitschrift für Physikalische Chemie, Neue Folge* are now available. The new series is the lawful continuation of *Zeitschrift für Physikalische Chemie* (founded in 1887), now being published by Akademische Verlagsgesellschaft m.b.H., Holbeinstrasse 25-27, Frankfurt am Main, by arrangement with the original owners and in cooperation with Professors K. F. Bonhoeffer, Th. Förster, W. Josz, and Georg-Maria Schwab, former editors of the prior series. Every effort will be made to restore this periodical to its previous reputation. An international advisory board of leading physico-chemists is now being formed. The May issue (Vol. 1, Nos. 1/2) contains original papers; these are not the same as those appearing in a periodical released under the same title in Leipzig, Soviet-Zone of Germany.

The Commonwealth Scientific and Industrial Research Organization, Australia, has published a special Supplement to the Second Edition of the "Union Catalogue of Scientific Periodicals in Australian Libraries." The Second Edition did not list journals that commenced publication after December 1945. The Supplement, although not directly amending or supplementing the entries that comprise the Second Edition, lists nearly 2000 new titles that have appeared since the cessation of World War II. It also shows many changes in the names of institutional and governmental organizations. Copies are available from the Tait Book Co. Pty. Ltd., 349 Collins St., Melbourne.

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Book Reviews

The Design of Social Research. Russell L. Ackoff. Univ. of Chicago Press, Chicago, 1953. 420 pp. Illus. \$7.50.

A famous economist once remarked that writing on methodology was like playing on a slide trombone; no one seemed to enjoy it except the person doing it. Ackoff has set out to disprove the validity of this dictum by producing a methodological textbook that is both an extremely useful presentation of recent developments in social science research and an intellectual challenge to the student and practitioner to do some hard thinking on the theoretical and practical issues involved in the scientific study of human social behavior.

Ackoff admirably strikes a judicious balance between the logical imperatives of properly designed research and the practical considerations involved in the actual conduct of social surveys. The first part of the book deals with basic definitions of designed research, the crucial significance of the proper formulation of the problem, and the logical basis of the idealized research design. The bulk of the volume is concerned with practical research procedures considered in their statistical, observational, and operational phases. The statistical chapters cover sampling, the logic of statistical procedures, and tests of hypotheses. The last two chapters call attention to the practical adjustments and administrative considerations that must be included in the research plan. In these chapters, the author draws heavily on his experience as survey statistician in the Bureau of the Census.

The volume is intended as a textbook; each chapter includes discussion topics, exercises, suggested readings, and bibliographic references. However, in several chapters, the effort to be comprehensive has led to a sacrifice of compactness. I believe, therefore, that this work will be more useful as a reference manual than as a systematic textbook. To those engaged in social research, it provides suggestive guidelines for the evaluation and selection of alternative methods. For the nonpractitioner, it offers insight and understanding of the problems faced and the methods utilized by those dedicated to the scientific study of social phenomena.

The author recognizes the difficulties in social research that stem from the absence of theory. Fortunately, as he points out, much significant social research to date has been performed by people whose intuition, judgment, and artistry were well in advance of their method and theoretical models. This volume is a testimonial to the many social scientists and statistical survey specialists whose concerted efforts are achieving, in modest measure, that reduction in empiricism which, in Conant's view, is the essence of science.

HARRY ALPERT

National Science Foundation, Washington, D.C.

Human Embryology. ed. 2. Bradley M. Patten. Blackiston, New York, 1953. 798 pp. Illus. + charts.

The chapter to chapter contents of this book are, with a few exceptions, unchanged from the preceding edition. The first eight chapters (pp. 1-232) are devoted to the general features of embryological development, the remaining ones (pp. 233-705) deal in sequence with the various organs and organ systems of the body. The book itself has been lengthened by only a few pages.

The original, very well chosen bibliography has been carried over unchanged from the preceding edition. To this a supplementary list, covering the 1945 to 1953 references, has been appended. A chapter to chapter grouping of both lists has been retained. Thus arranged, this bibliography well documents the text, of which it is an important and useful part.

Since the publication of the first edition of *Human Embryology*, a number of embryos have been added to the remarkable series already obtained by J. Rock and A. T. Hertig. This priceless new material has pushed back our horizon of unknown human development from the eleventh to the seventh day and has furnished valuable, although less complete, information concerning segmentation of the human embryo. These well-preserved human embryos, together with the complete Macaque series of the Carnegie Embryological Laboratory, constitute a superb background for an adequate interpretation of early human embryological development.

With such primate material now available, one may quite logically question the further dependence upon subprimate animal forms in reaching a satisfactory understanding of human development during the hitherto little understood first 2 wk of gestation.

It is evident that Patten does not believe in so radical a departure from time-honored custom, because, after an adequate description of this formative period, as shown by human embryos, he goes to some length in bringing the human embryo into conformity with that of the previously described pig. This is regrettable because, although the human being and the pig ultimately do become comparable in extra-embryonic structure, the origins of these similar parts are completely different and, so, should not be confused one with the other.

The handling of this, admittedly controversial, stage of human development is, in my opinion, the least satisfactory of any portion of an otherwise excellent textbook.

The recent work of H. Taussig and A. Blalock in correcting certain abnormalities of the great vessels of the heart, has led to the desirability of a more detailed explanation of the embryology of this type of abnormality. This Patten has quite successfully accomplished. Certain other features related to the heart and aortic arches have also been amplified.

In brief, this is a very useful book and is one that should rank high with students of human embryology.

CARL L. DAVIS

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University of Maryland, Baltimore

Radioisotope Techniques. Vol. I. Medical and Physiological Applications. Proceedings of the Isotope Techniques Conference, Oxford, July 1951, sponsored by the Atomic Energy Research Establishment. H. M. Stationery Office, London, 1953. vi + 466 pp. Illus. + plates. £2 10s.

This conference was held at Oxford, July 16-20, 1951, for the purpose of bringing together the people who use isotopes in varied biological studies. The participants were chiefly British and French, with a sprinkling of men from Scandinavia, West Germany, Switzerland, Italy, Portugal, and Canada. The 98 papers presented were divided into a total of 30 separate sections under the broad headings of "Therapy and Diagnosis," "Biochemistry and Metabolic Studies," and "Plant Biochemistry." Only 10 papers were devoted to the latter, but all were extraordinarily interesting.

The general plan of each session was to have the first paper describe the scope and theory of the phase under consideration; one to four more shorter papers then dealt with special applications.

Since the data represent the state of advancement as of July 1951, it is difficult to pass any sound opinion on their present usefulness. Obviously, they are valuable from a historical point of view for those reviewing the subject or for those reading to revise the orientation of their experiments. Insofar as memory serves, the papers indicate that we in the United States were probably ahead of our British and Continental colleagues in instrumentation, in breadth of exploration of the over-all field, and in a few certain isolated applications. They, on the other hand, were well into the basic aspects of many problems, which, as reported in collected form here, it is a pleasure to read.

H. D. BRUNER

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Emory, Georgia

Magnetic Cooling. C. G. B. Garrett. Harvard Univ. Press, Cambridge, Mass.; Wiley, New York, 1954. 110 pp. Illus. \$4.50.

This book provides the first treatment of the subject of magnetic cooling since the appearance in 1940 of the celebrated monograph by Casimir. It is, in effect, a revised edition of the latter, with an entirely new chapter on cooperative effects and a thorough, if condensed, coverage of the experimental work done between 1940 and 1952 on both paramagnetics and other materials at temperatures below 1°K.

Garrett has favored the descriptive, or "physical," approach throughout, and his chapter on cooperative

effects is especially interesting. As the publishers point out, "the author stresses those aspects of the subject with which he has been most closely associated," but fortunately these aspects are sufficiently numerous to maintain a reasonable balance. The section dealing with experiments on "other materials" below 1°K is probably shorter than the title of the book would suggest, although the author, by skillful abstraction of the essential features, has succeeded in covering in a short space the majority of the important experiments reported by late 1952. As a result, the reader is provided with a clear picture of the diversity of such researches and of the current rapid development in the field.

One notices a number of minor errors and points for criticism but few that warrant mention, especially in a brief review. Of the limited space available in a monograph, rather too much has been devoted to a discussion of the "purely academic" question of what is the correct expression for the energy of a magnetized specimen, and the important question of the validity of heating by gamma rays in calorimetric determinations is dismissed by a brief mention of the objection that has been lodged against the method. Absolute temperature determinations made in the millidegree region by different methods show wide disagreement (the latest work on potassium chromic alum provides a graphic example), and a short critical examination of possible causes would have been of value.

In summary, *Magnetic Cooling* is extremely "readable," timely, and useful to both students and research workers, especially so by reason of the provision throughout of a wealth of references to original publications. It should convey to the general reader a clear impression of a fascinating and rapidly expanding field and stimulate a wider appreciation of the potentialities of the temperature region below 1°K.

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Washington 25, D.C.

Hypnotism: An Objective Study in Suggestibility.

André M. Weitzenhoffer. Wiley, New York; Chapman & Hall, London, 1953. 380 pp. \$6.

Since the publication in 1933 of C. L. Hull's classical study, *Hypnosis and Suggestibility: An Experimental Approach*, more than 500 reports and books related to the subject have been published. During this interim, new techniques have been devised and old techniques have been revised; much information formerly based on inconclusive experiments or personal history can now be recorded and evaluated in the light of accepted present-day research standards, and the applications of hypnosis have made apparent the need for a thorough, factual appraisal and integration of the data relevant to the basic phenomena of hypnosis and suggestibility.

André Weitzenhoffer's book successfully presents "a critical and integrated compilation and appraisal

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of the scientific work done to date in this field." It will stand as a milestone in the scientific investigation of hypnosis.

The structure of the book is well planned. Each of the four chapters is introduced by a summary of the results and conclusions of other investigators and is followed by the interpretation and conclusions of the author. The investigations chosen for discussion tend to eliminate those items of only a historical or empirical nature. Some excellent references have been omitted to conserve space and, for the same reason, many of the arguments are quite brief. However, condensation and conciseness do not impair the value of the book.

The first chapter embraces a short history of, and an introduction to, hypnosis. The second and third chapters are devoted to a consideration of the intrinsic and extrinsic characteristics of suggestibility and hypnosis. These chapters, which are designed to establish the experimental foundations of hypnosis, constitute the major portion of the book. In keeping with such a purpose, the author has given little attention to hypnotic techniques or therapy as such. The final chapter constitutes an exposition of the various theories of hypnosis followed by the presentation of a new theoretical approach formulated by the author.

Weitzenhoffer's text is well supplemented by adequate charts and diagrams and an extensive bibliography. It should stand beside Hull's classical work as a source book for today's student of human behavior and management.

W. O. RAMSEY

School of Dentistry, University of Maryland

New Books

Vegetable and Flower Seed Production. Leslie R. Hawthorn and Leonard H. Pollard. Blakiston, New York, 1954. 626 pp. Illus. \$7.50.

The Physiology of Man. L. L. Langley and E. Cherashkin. McGraw-Hill, New York, 1954. 609 pp. Illus. \$5.50.

Avian Physiology. Paul D. Sturkie. Comstock, Cornell Univ. Press, Ithaca, N.Y., 1954. 423 pp. Illus. \$6.

Probability and Information Theory, with Applications to Radar. P. M. Woodward. McGraw-Hill, New York; Pergamon Press, London, 1953. 128 pp. Illus. \$4.50.

Physics for Medical Students. J. S. Rogers. Melbourne Univ. Press, Melbourne, Australia; Cambridge Univ. Press, New York, 1953. 405 pp. Illus. \$5.50.

Progress in Nuclear Physics. Vol. 3. O. R. Frisch, Ed. Academic Press, New York; Pergamon Press, London, 1953. 279 pp. Illus. + plates. \$9.50.

Cold Injury. Transactions of the Second Conference, Nov. 20-21, 1952. M. Irené Ferrer, Ed. Josiah Macy, Jr., Foundation, New York, 1954. 242 pp. Illus. + color plates. \$4.

Laboratory Studies in Biology. Addison E. Lee and Osmond P. Breland. Harper, New York, 1954. xi + 253 pp. Illus. \$3.50.

Introductory College Mathematics. Chester George Jaeger and Harold Maile Bacon. Harper, New York, 1954. xii + 382 pp. Illus. \$4.75.

Experimental Inorganic Chemistry. W. G. Palmer. Cambridge Univ. Press, New York, 1954. 578 pp. Illus. \$9.

First Course in Calculus. Hollis R. Cooley. Wiley, New York; Chapman & Hall, London, 1954. xii + 643 pp. Illus. \$6.

Catalysis. Vol. I. Fundamental principles (Part I). Paul H. Emmett, Ed. Reinhold, New York, 1954. 394 pp. Illus. \$10.

Animal Breeding. ed. 5. Laurence M. Winters. With additional chapters by William Rempel and John N. Cummings. Wiley, New York; Chapman & Hall, London, 1954. ix + 420 pp. Illus. \$5.75.

The Determination of Crystal Structures. H. Lipsen. Vol. III, The Crystalline State; Sir Lawrence Bragg, Ed. G. Bell, London; Macmillan, New York, 1953. ix + 345 pp. Illus. + plates. \$8.

The Mechanism of Economic Systems. An approach to the problem of economic stabilization from the point of view of control-system engineering. Arnold Tustin. Harvard Univ. Press, Cambridge, Mass., 1953. xi + 161 pp. Illus. \$5.

Die Bedeutung des Blutchemismus. Besonders in Beziehung zu Tumorbildung und Tumorbau. Teil II. Der Zellund Gewebestoffwechsel. Als Innere Krankheitsabingung. Ernst Leupold. Georg Thieme, Stuttgart, Germany, 1954. 207 pp. Illus. DM 48 (\$11.44).

Handbook of Freshwater Fishery Biology with the First Supplement. Kenneth D. Carlander. Wm. C. Brown, Dubuque, Iowa, 1953. v + 429 pp. \$6.50.

A Symposium on the Mechanism of Enzyme Action. William D. McElroy and Bentley Glass, Eds. Johns Hopkins Press, Baltimore, Md., 1954. xvi + 819 pp. Illus. \$11.

Petrography. An introduction to the study of rocks in thin sections. Howel Williams, Francis J. Turner, and Charles M. Gilbert. W. H. Freeman, San Francisco, Calif., 1954. x + 406 pp. Illus. \$6.50.

A Practical Manual of Medical and Biological Staining Techniques. Edward Gurr. Interscience, New York, 1953. xix + 320 pp. \$4.

Sweet Corn. Walter A. Huelsen. Interscience, New York-London, 1954. xv + 409 pp. Illus. \$10.50.

The Biology of the Cryptic Fauna of Forests. R. F. Lawrence. A. A. Balkema, Capetown-Amsterdam, 1953. 408 pp. Illus. 50s.

Fresh Water from the Ocean. Cecil B. Ellis. Ronald Press, New York, 1954. xi + 217 pp. Illus. \$5.

Antiseptics, Disinfectants, Fungicides, and Chemical and Physical Sterilization. George F. Reddish, Ed. Lea & Febiger, Philadelphia, 1954. 841 pp. Illus. \$15.

Introductory Biology. ed. 2. Andrew Stauffer, Ed. Van Nostrand, New York-London, 1954. xvii + 802 pp. Illus. \$6.50.

Biology. Paul B. Weisz. McGraw-Hill, New York, 1954. 679 pp. Illus. \$6.50.

The Size and Growth of Tissue Cells. Joseph G. Hoffman. Charles C. Thomas, Springfield, Ill., 1953. 102 pp. Illus. \$4.

Elements of Electrical Engineering. ed. 6. Arthur L. Cook and Clifford C. Carr. Wiley, New York; Chapman & Hall, London, 1954. 682 pp. Illus. \$6.75.

British Veterinary Codex 1953. Council of the Pharmaceutical Society of Great Britain. Pharmaceutical Press, London, 1953. 737 pp. 45s.

Adjustment to Physical Handicap and Illness: A Survey of the Social Psychology of Physique and Disability. Bull. 55, rev. 1953. Roger G. Barker et al. Social Sciences Research Council, New York, 1953. 440 pp. Illus. \$2.

- Culture and Diseases of Game Fishes.** H. S. Davis. Univ. of California Press, Berkeley-Los Angeles, 1953. 332 pp. Illus. \$5.
- Kinematics of Machines.** Rolland T. Hinkle. Prentice-Hall, New York, 1953. 231 pp. Illus. \$4.75.
- Fundamentals of Ecology.** Eugene P. Odum. Saunders, Philadelphia, 1953. 384 pp. Illus.
- The Cyclotron.** W. B. Mann. Methuen, London; Wiley, New York, 1953. 118 pp. Illus. \$2.
- The Grasshoppers and Locusts (Acridoidea) of Australia.** Vol. II. James A. G. Rehn. Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia, 1953. 270 pp. + 312 plates. £2.
- Die Welt der ungewohnten Dimensionen.** Versuch einer gemeinverständlichen Darstellung der modernen physik und ihrer philosophischen Folgerungen. Arnold Hilde-scheimer. A. S. Sijthoff's Uitgeverijmaatschappij N. V., Leiden, Netherlands, 1953. 368 pp. Illus. + plate. Dutch gulden 17.90.
- Modulation Theory.** Harold S. Black. Van Nostrand, New York-London, 1953. 363 pp. Illus. + plates. \$8.75.
- Nucleo-Cytoplasmic Relations in Micro-organisms.** Their bearing on cell heredity and differentiation. Boris Eph-russi. Oxford Univ. Press, New York, 1935. 127 pp. Illus. + plates. \$3.75.
- Atmospheric Electricity.** ed. 2. B. F. J. Schonland. Meth-uen, London; Wiley, New York, 1953. 95 pp. Illus. \$1.75.
- Practical Chromatography.** R. C. Brimely and F. C. Bar-rett. Reinhold, New York; Chapman & Hall, London, 1953. 128 pp. Illus. + plates. \$5.
- The Spinal Cord.** A Ciba Foundation Symposium. J. L. Malcolm, J. A. B. Gray, and G. E. W. Wolstenholme, Eds. Little, Brown, Boston, 1953. 300 pp. Illus. + plates. \$6.50.
- 50-100 Binomial Tables.** Harry G. Romig. Wiley, New York, 1953. 172 pp. \$4.
- Atlas of Exfoliative Cytology.** George N. Papanicolaou. Harvard Univ. Press, Cambridge, Mass., 1954 (For the Commonwealth Fund). 9 chaps. + bibliog. + ind. Plates \$18.
- Electroanalytic Chemistry.** James J. Lingano. Intersci-ence, New York, 1953. 448 pp. Illus. \$8.50.
- Administrative Medicine.** Transactions of the First Con-ference, March 9-11, 1953. George S. Stevenson, Ed. Josiah Macy, Jr., Foundation, New York, 1953. 176 pp. Illus. \$3.
- Tissue Culture As Applied.** Especially within bacteriol-ogy and immunology. Ben Kimura. Ejnar Munksgaard, Copenhagen, Denmark, 1953. 273 pp. Illus. Danish kroner 14.
- Electricity and Magnetism.** Edson Ruth Peck. McGraw-Hill, New York, 1953. 476 pp. Illus. \$7.50.
- Synthesis and Metabolism of Adrenocortical Steroids.** Ciba Foundation Colloquia on Endocrinology, Vol. VII. W. Klyne, G. E. W. Wolstenholme, and Margaret P. Cameron, Eds. Little, Brown, Boston, 1953. 297 pp. pp. Illus. \$6.75.
- Higher Transcendental Functions.** Vol. II. Based, in part, on notes left by Harry Bateman, compiled by Staff of the Bateman Manuscript Project, California Institute of Technology. McGraw-Hill, New York-London, 1953. 396 pp. \$7.50.
- Chromatographic Methods of Inorganic Analysis:** With special reference to paper chromatography. F. H. Pol-lard and J. F. W. McOmie. Academic Press, New York; Butterworths, London, 1953. 192 pp. Illus. + plates. \$5.50.

Miscellaneous Publications

- The Silting of Caonillas Reservoir, Puerto Rico.** SCS-TP-119. John J. Noll. Soil Conservation Service, USDA, Washington 25, D.C., 1953. 22 pp. Illus.
- Revista Colombiana de Antropología.** Vol. 1, No. 1. Insti-tuto Colombiano de Antropología, Bogotá, 1953. 458 pp. Illus.
- A Coniferous Petrified Forest in Patagonia.** M. G. Calder. 41 pp. Illus. + plates. 12s.
- Solution of the Piltown Problem.** J. S. Weiner et al. 7 pp. + plates. British Mu-seum (Natural History), London, 1953.
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Technical Papers

Abnormal Lipid in Coronary Arteries and Aortic Sclerosis in Young Rats Fed a Choline-Deficient Diet*

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Lipid deposits in walls of coronary arteries and aorta and grossly evident aortic sclerosis in young rats have been observed after short periods on a low-choline, high-fat diet. The lesions are of special interest because they developed rapidly in intact animals fed diets that did not contain supplements of cholesterol. These diets contained high levels of protein (30 percent) and fat (35 percent) and were relatively low in methionine (520 mg/100 g of food). We have previously reported vascular lesions in older rats maintained for longer periods on choline-deficient diets that contained lower levels of both fat and protein (1). Alterations in the vessels of the young animals are regarded as the acute form of the chronic lesions encountered in older rats.

One hundred thirty-seven young male rats (120 g) of the Wistar strain were used. Thirty-six of these were fed the basal diet (2) supplemented with 0.85 percent choline chloride. These controls were offered and, over the experimental period of 4 wk, consumed the same amount of food as did the 101 experimental animals of the same age and weight that ingested the basal, unsupplemented diet *ad libitum*. Control animals and survivors in the experimental group were sacrificed under ether anesthesia at the end of the 4-wk period. Half of the animals on the low-choline diet succumbed to acute hemorrhagic renal lesions before the end of this period.

Gross and microscopic examinations revealed that abnormalities of the cardiovascular system were absent in all 36 choline-supplemented controls but had developed in 22 of the choline-deficient rats (22 percent). In half of the latter, the sclerotic aortic changes were grossly evident throughout the thoracic aorta. In one instance, this had developed in a rat that died of acute renal injury after only 17 days of choline deficiency.

Microscopically, the aortic lesions consisted of intimal and medial deposits of lipid, frequently associated with pathological amounts of calcium salts in the media. Coronary arteries contained intimal and medial deposits of stainable fat (Figs. 1, 2), but calcification has not been observed in these arteries. In some cases, intimal hyperplasia was associated with abnormal intimal lipid (coronary arterial lipoidosis). In every instance in which fat was demonstrable in

lining endothelial cells, the latter were swollen. Lipid deposits appear to constitute the initial stage in the pathogenesis of the lesions of both coronary arteries and aortas.

In a subsequent experiment (3), 40 male rats weighing on the average 100 g were used (85 to 125 g). These animals were younger than those in the initial experiment. Twenty rats were fed the basal, choline-deficient diet *ad libitum*, and the remainder were offered and consumed the same amount of the choline-supplemented (0.85 percent) diet. Fifteen of the choline-deficient rats succumbed either to hemorrhagic renal lesions or to cardiac necrosis (4). Autopsy revealed, on either gross or microscopic examination, that 18 of the 20 choline-deficient rats had developed lesions of coronary arteries or aortas or both, whereas at the end of 4 wk, when all animals were sacrificed, the vessels of the choline-supplemented rats were found to be entirely normal.

Lehr and associates (5) have described the rapid production of similar vascular lesions in rats in which renal injury followed administration of sodium N-acetyl sulfathiazole. Their findings suggest that renal injury induced by the low-choline diet may be an important factor in the production of the lesions described here. But Lehr *et al.* did not report lipid deposits in the affected vessels, and it may be that this feature characterizes the changes induced by choline deficiency.

We have observed grossly evident aortic sclerosis in the absence of what appears to be a significant degree of renal damage, but this is the rare exception to their otherwise constant association. Nevertheless, the exceptions may indicate that vascular and renal changes are not necessarily etiologically dependent.

Wissler *et al.* (6) have reported that choline supplements actually favor the development of lipomatous and atheromatous lesions in coronary arteries of rats

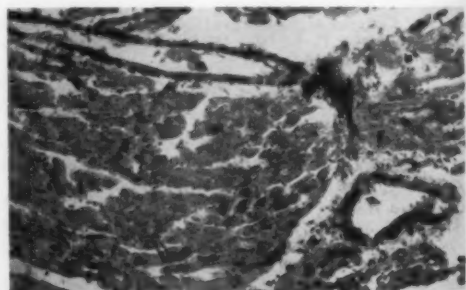


Fig. 1. Low-power ($\times 50$) photomicrograph of stem-branches of coronary arteries supplying the left ventricle of the heart of a rat that consumed the basal, choline-deficient diet for 17 days. Stainable fat (black) is deposited throughout most portions of the arterial walls. The surrounding cardiac muscle is relatively normal. Oil red O stain photographed through Wratten B and G filters.

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Fig. 2. Preparation (black) Lipid droplets

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Fig. 2. High-power ($\times 600$) photomicrograph of similar preparation to that shown above. Masses of stainable fat (black) are deposited in all portions of the arterial wall. Lipid in intimal endothelial cells is in the form of fine droplets.

that received a high-fat, high-choline ration containing cholesterol. Lesions developed more rapidly in similar rats that received 1 percent NaCl in their drinking water and were given anti-rat-kidney serum, desoxycorticosterone acetate, and sesame oil injections. The arterial lesions were directly associated with the renal damage that these measures produce. Since choline exerted no protective effect in Wissler's experiments, it is possible that the lesions he has observed and those reported here are not closely related.

The lesions that McCormick and Holman (7) have described in dogs fed a high-fat diet following the production of a "standard" amount of renal damage may be more closely related to those that we have observed in choline-deficient rats. It would be interesting to know whether high levels of dietary choline would exert any protective influence on the vascular lesions seen in Holman's type of experiment.

Subsequent to our reports (1) concerning the production of vascular lesions in choline-deficient rats, Mann *et al.* (8) have produced atherosclerosis in *Cebus* monkeys by giving them large amounts of cholesterol in methionine-deficient diets. Methionine supplements prevented atherosclerosis in control animals. Mann has not specifically investigated the effects of choline deficiency on the vessels of monkeys, and it is possible that he is observing a manifestation of the lipotropic action of methionine in his experiments.

Earlier reports from our laboratory concerning the role of choline in the development of cholesterol-induced atheroma were limited to investigations in rabbits in which choline was added to a basal diet that already contained appreciable amounts of lipotropic factors. The effects of diets very low in lipotropic factors were not studied in that species (9).

We believe that the results of these studies using the rat indicate that an adequate intake of choline favors the maintenance of not only a healthy liver and kidney but also a normal cardiovascular system in young rats. Recent *in vitro* studies by Artom (10) have shown that the rate of fatty-acid oxidation by slices of livers, kidneys, and hearts of choline-deficient rats is enhanced if the animals are given choline just prior

to the time of sacrifice. Morphologic lesions in all these tissues have been found to begin with stainable deposits of fat which precede the irreversible changes associated with cirrhosis, renal damage, and cardiac necrosis.

If it should prove that the vascular lesions reported here are primarily due to a relative lack of lipotropic substances in the diet, another of the factors necessary to maintain the healthy state of the walls of blood vessels will have been recognized. It will obviously be necessary to confirm these findings on other species of laboratory animals before their possible clinical significance is considered.

We suggest that the term *lipotropic* may now be extended to include the prevention of the accumulation of abnormal (stainable) fat not only in the liver and kidneys but also in the heart and blood vessels of animals that exhibit these lesions when choline and its precursors are withdrawn from the diet.

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Retardation of Maturation in Magnolia Flowers by Maleic Hydrazide

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It has been shown that MH (maleic hydrazide) inhibits or retards several processes in plants. Cell division is inhibited in the root tips of *Vicia faba* (1) and onion (2); respiration is retarded in onions through partial inactivation or inhibition of one or more of the dehydrogenases (3); softening of apples is retarded and respiration is reduced, as measured by the quantity of CO_2 given off (4); and in some cases MH appears to act as an antiauxin (5). Evidence is presented in this paper to show that MH retards the aging processes in the flowers of *Magnolia grandiflora* L., the ability of MH to inhibit these processes being correlated with the quantity of starch in the perianth segments at the time of application.

In the Los Angeles area, the flowers of *Magnolia grandiflora* L. last 4 to 5 days. During the first day, they open partially, forming a loose bud (Figs. 1, 4). Anthesis occurs during the morning of the second day, the pollen being shed and the stamens abscised by evening (Fig. 2). During the subsequent 2 or 3 days, the perianth segments turn brown, generally being a deep brown and partially dry by the time of abscission on the fourth or fifth day.

MH-30 and MH-40, commercial preparations of the diethanolamine salt, were used in these experiments. MH-30 was painted on the perianth segments, in concentrations of from 0.1 to 15.0 percent, at various times throughout the principal blooming period. Concentrations of less than 5.0 percent had no noticeable effect. When applied in concentrations greater than 5.0 percent during the first day (loose buds), the areas painted remained white and turgid throughout the life of the flower. These areas were sharply defined, usually being limited to that portion actually touched by the MH-30. The segments were collected at time of abscission and kept under normal atmospheric conditions. Fifteen days after abscission the untreated portions of the segment were deep brown and crumbled, while the treated portion was cream colored and leathery.

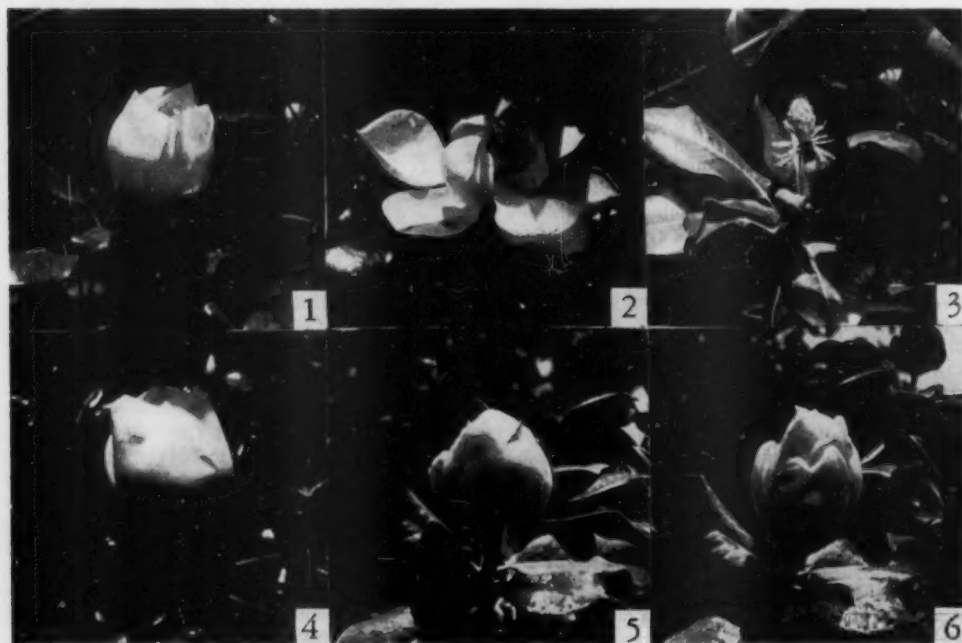
Applications made during the second day produced decreasing effects: those made during the early morn-

ing hours produced a reaction almost as pronounced as those of the first day, while applications made at noon produced more localized effects of shorter duration. There was no noticeable effect when MH was applied in the evening of the second day or during the remainder of the life of the flower.

Flowers were sprayed with a 10-percent solution of MH-40 at various times throughout the normal blooming period. The normal maturation processes were inhibited in the flowers that were sprayed during the first day (loose buds) (Figs. 4-6). These flowers did not open further, and the perianth segments remained white except for the edges and some small spots, the processes causing browning of the perianth segments being inhibited (Figs. 5, 6). The normal abscission of the perianth segments was also inhibited. The immature fruits abscised in from 3 to 4 wk, and at that time some segments, although partially brown and dry, were still attached.

Flowers sprayed during the afternoon of the second day showed only slight retardation of the browning processes, generally being lighter brown at the time of abscission. Perianth segment abscission was not retarded or only slightly so. No effects were noted on flowers sprayed during later stages of maturation.

MH-30 in lanolin was applied in concentrations of 8 percent at the base of some perianth segments during the first day. Abscission of these segments was



Figs. 1-3. Untreated flowers of *Magnolia grandiflora* L., showing stages in development: (1) first day, loose bud; (2) second day, anthesis complete and stamens in process of abscising; (3) fifth day, perianth segments abscised the previous evening. Figs. 4-6. Flowers sprayed with 10 percent solution of MH-40: (4) first day, flowers at time of application; (5) second day; (6) fifth day. Both flowers opened the same day. Photographs were taken at noon.

inhibited, while adjacent segments, either without application or with pure lanolin applied, abscised normally. Only the portion of the segment to which the MH was applied remained white and turgid; the rest browned and dried in the normal length of time.

Cytological examinations of untreated perianth segments were made at intervals during the life of the flower to ascertain the amount of starch normally present. There is an abundance of starch in the parenchyma cells of the segments during the first day. During the second day, starch decreases rapidly; in the early morning, there is as much present as on the first day; at noon, there is about one-half as much; and in the evening, starch is absent or nearly so. Examination of flowers in later stages showed starch to be absent. In treated material, however, considerable starch remains for a longer period of time.

The foregoing observations indicate that the ability of the MH to retard maturation processes is related to the amount of starch present at the time of application. There is no noticeable effect when starch grains are absent or nearly so. The retardation of starch digestion in the presence of MH may account in part for the lowered respiration observed by others. Further experimental work is in progress.

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Intestinal Intussusception in Chronic Nephrectomized Dogs Maintained by Peritoneal Dialysis*

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Despite widespread interest in clinical aspects of intestinal intussusception, few experimental studies have been made. These have consisted of the deliberate production of intussusceptions by direct stimulation of the animal intestine by faradic current, acetylcholine, salt crystals, and actual manual manipulation (1), and by faradic stimulation of the premotor area of the monkey cerebral cortex (2). Intussusceptions have been cited as a frequent complication in very young dogs following a constricting ligature of one renal artery (3) but have never been encountered by Goldblatt in some 1500 renal hypertensive dog preparations (4).

This paper presents an incidence of intestinal in-

tussusception as a complication in 11 of 36 (30.6 percent) chronic bilaterally nephrectomized dogs maintained for from 6 to 111 days on a low-salt diet by intermittent peritoneal dialysis as described elsewhere (5). Either a 17-gage 3½-in. needle or P.E. 320 polyethylene tubing was used in the abdominal cavity for the dialysis (6). This incidence is believed to be the highest for intestinal intussusception so far reported as an experimental complication. Muirhead et al. (7) found intussusceptions in 11 percent of 71 nephrectomized dogs untreated or subjected to the artificial kidney.

Nine of the 11 intussusceptions were single, and two were dual; 10 were forward, and one was retrograde. According to the classification reported by Finkelstein (8), four were enteric, four ileocolic, one colic, and two enteric-ileocolic (dual). They occurred on post-nephrectomy days 2, 4, 5, 6, 7, 8, 10, 11, 15, and 35. Six intussuscepta were necrotic and presumably not recent; five were moderately to marked congested and presumably were recent. Five of the dogs were sacrificed when obstruction appeared imminent; six were found dead. In three of the ileocolic cases, the dark red gangrenous ileal intussusceptum protruded through the anus as far as 6 in. An intussusception was, for the most part, manifest by failure to retain food, by watery bile-stained vomitus and yellow-tan colored watery diarrhea, gradually becoming tarry and frankly bloody when the lower tract was involved. The intussusceptum was palpated rectally on four occasions and was diagnosed fluoroscopically on another (9).

Ten normal dogs were maintained on the same diet and dialysis schedule as the nephrectomized series for from 9 to 12 days, then were kept under observation for up to 18 days. No intussusceptions occurred. Consequently, such technique of maintenance alone was probably not the cause of the intussusceptions.

Although the cause of the intussusceptions was not readily apparent in this study, it could have been related to the irritation of the gastrointestinal tract, manifest in some of the dogs by hyperemia, congestion, and petechial hemorrhages in the mucosa, presumably due to some toxic substance incident to the absence of the kidneys. The combination of such irritation with visceral peritoneal irritation from the indwelling dialysis fluid might have created certain hypermotile regions of the intestine which acted as a nidus for an intussusception.

The possibility of bacterial contamination from the dialysis fluid as a cause of intussusception has been considered but insufficiently studied to warrant any definite conclusions. A preliminary investigation of this point was recently carried out on only a few of the aforementioned animals, and the data are reported elsewhere (10). Counts of bacterial colonies in cultured dialysis fluid before administration into, and after retention in, the abdominal cavity for 1½ to 2 hr were determined in 7 control dogs. All solutions put into the abdomen contained per liter the usual 25 mg of streptomycin and 25,000 units of crystalline

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penicillin used throughout the study and were sterile. In six animals, all withdrawn samples were sterile; in one, severely contaminated. Four of the foregoing six animals with sterile dialysis fluids were subsequently nephrectomized. One developed an intussusception. All withdrawn dialysis fluids initially were contaminated but subsequently could be made sterile by the intramuscular injection of penicillin. Nephrectomy appears to lower the resistance of the animal to bacterial contamination (10). Since the nature of the contaminant was not investigated, no definite statement concerning the source of such contamination can be made at this time.

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A Method of Making Prefilled Microelectrodes

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In making microelectrodes for intracellular recordings, the greatest difficulty encountered is in the step of filling the tip with electrolyte. The method described by Ling and Gerard (1) uses fairly vigorous boiling to drive out the air, but this process destroys a large percentage of the microtips. Nastuk (2) has recently described another method in which boiling is avoided, but it requires several delicate manipulations.

The difficulty of filling the microelectrode can be circumvented by drawing the tips from capillary tubes that have been previously filled and maintained in a closed electrolyte system during the pulling. A specific application in connection with the Gamma pipette puller will be described. In this instrument, which is operated by gravitational force, the capillary is in a horizontal position and lengthens as heat is applied to it by a hot wire. For drawing prefilled microelectrodes, lucite blocks carrying deep wells filled with the electrolyte solution in use are attached to the jaw elements of the puller (Fig. 1). Capillary tubing of

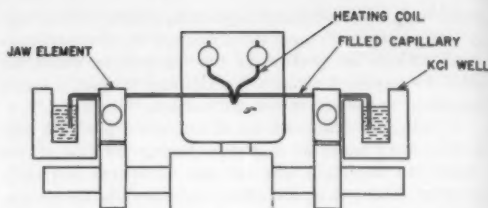


Fig. 1. Diagrammatic representation of the prefilled glass capillary in the Gamma pipette puller modified by adding a lucite well at each of the jaw elements.

appropriate lengths is bent at both ends. The bent tubing is first filled with the electrolyte solution and then is inserted into the jaw elements of the puller with the ends dipped in the reservoirs.

When heat is applied to the middle of the filled capillary, thermal expansion expels the fluid from the heated region into the wells. As the capillary is pulled apart to form the microtips, these are again filled by the electrolyte drawn from the reservoir. The filled electrodes are then immediately removed from the clamps and are hung vertically with the tips downward. This allows any large air pockets to rise toward the coarse end of the capillary where they can be dealt with easily.

In about 40 percent of the microelectrodes made in this manner, small air bubbles remain in the shaftlet or in the tip. However, when these electrodes are stored for a few days on a rack in a container filled with the electrolyte, most of the small air bubbles disappear. Thus most of the microelectrodes become usable without further manipulation.

Several other variants of this technique have been used successfully with the Gamma puller and other instruments. Microelectrodes with 1.0 to 2 μ tips are made with the greatest of ease from capillary tubes of 0.7 mm outside diameter. For tips smaller than 1 μ ,

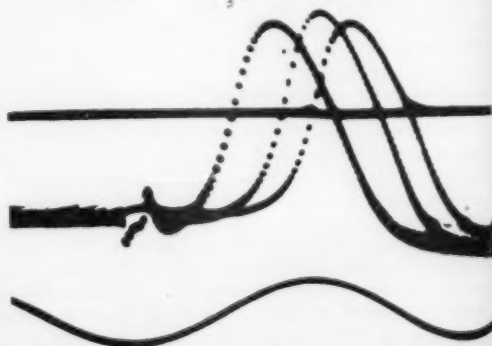


Fig. 2. Simultaneous records of activity at three microelectrodes inserted into a squid giant axon of diameter 480 μ . The distances between the electrodes (from left to right) were 3.7 and 2.5 mm. The resting potential (50 mv) is indicated by the displacement of the three electrode traces from the base line. Spike heights, 94 to 100 mv. Time curve, 1000 cy/sec.

prefilled capillary tubes are first narrowed on the puller to 0.3 to 0.4 mm for a short segment which is allowed to cool and refill with the electrolyte before being drawn to form microtips. This method of preparing microelectrodes has been employed continuously during the past 2 yr in connection with investigations of intracellular potentials in the squid giant axon (3), in the electroplaques of the electric eel (4), and in cardiac muscle fibers and spinal ganglion cells grown in tissue culture (5, 6). As many as three such microelectrodes have been inserted at one time into a region of the squid giant axon as small as 3 mm without damage to the spike height (Fig. 2).

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Differences in the Rate of Reduction-Oxidation Potentials in Salivary Samples of Certain Groups of Individuals

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Salivary redox potentials as a function of time have been reported in patients with dental caries (1), in patients with coronary heart disease (2), and in putatively normal individuals (2). This paper pertains primarily to a study of redox potential patterns in a group of mentally defective individuals within a single state institution (3). The salivary redox pattern of

these individuals as a group differed from the normal and from the coronary heart disease group when examined statistically.

Intensities of electron transfer were observed in saliva in a group of 57 mentally defective males whose chronological ages varied from 10 to 37 yr. Their mental ages varied from 4 to 10 yr, and the IQ average was 41. Four young adults (two males aged 24 and 29 yr, and two females aged 24 and 26 yr) and a boy of 11 had been tested repeatedly to determine duplicability and reliability of the procedure. These are not included in any of the three groups of the main study reported here.

In a previous publication (2), we reported intensities of electron transfer in saliva for a group of 66 men who had had at least 6 mo activity after having experienced myocardial infarction prior to the age of 40, and in a group of 73 healthy working males comparable to the infarction group by being of roughly similar age and ethnic origin.

About 1.5 ml of saliva was collected from each individual directly into a 5-ml beaker without physical or chemical stimulation. At least 2 hr had elapsed after eating, drinking, or smoking prior to the collection of the salivary sample. This freshly collected sample was immediately tested in a Beckman potentiometer (laboratory model G) with standard calomel-platinum electrodes. The results are shown in Table 1.

From the data plotted in Fig. 1, several characteristics are apparent. The trend is downward (negative direction) from a mean of approximately +280 mv as a starting potential for all three groups. Over a period of 30 min, the mean potential reaches -132 mv for the normal healthy males, -246 mv for the coronary heart disease group, and +11 for the mentally defective group.

It is also apparent from Fig. 1 that in the coronary heart disease group the electron transfer shows at all intervals greater negativity than either the control group or the mentally defective group. The difference is systematic, and the absolute differences between the groups increase with time.

Table 1. Salivary redox potentials in 73 control males, 66 male patients with coronary heart disease, and 57 mentally defective male individuals.

Time (min)	Control			Coronary heart disease			Mentally defective		
	No.*	\bar{X} (mv)	S.E.	No.*	\bar{X} (mv)	S.E.	No.	\bar{X} (mv)	S.E.
1/4	73	280.0	5.14	66	270.5	5.93	57	275	5.71
1	70	253.0	5.11	59	239.0	8.18	57	255	7.03
2	69	243.0	6.19	60	213.0	9.67	57	233	10.44
3	67	202.0	6.76	57	179.5	12.40	57	216	14.43
4	63	195.0	8.11	61	157.0	13.90	57	209	12.02
5	73	171.0	9.23	63	133.5	16.72	57	196	13.44
10	73	93.5	16.49	60	0.5	28.77	57	145	22.05
15	71	23.5	22.71	62	- 98.5	33.76	57	110	24.77
20	71	- 35.5	28.09	61	-156.5	36.89	57	70	26.62
25	69	- 85.5	29.39	61	-180.5	35.89	57	38	28.41
30	70	-132.5	30.23	62	-246.5	36.70	57	11	29.54

* The numbers in these two columns vary because readings for certain intervals were occasionally missed.

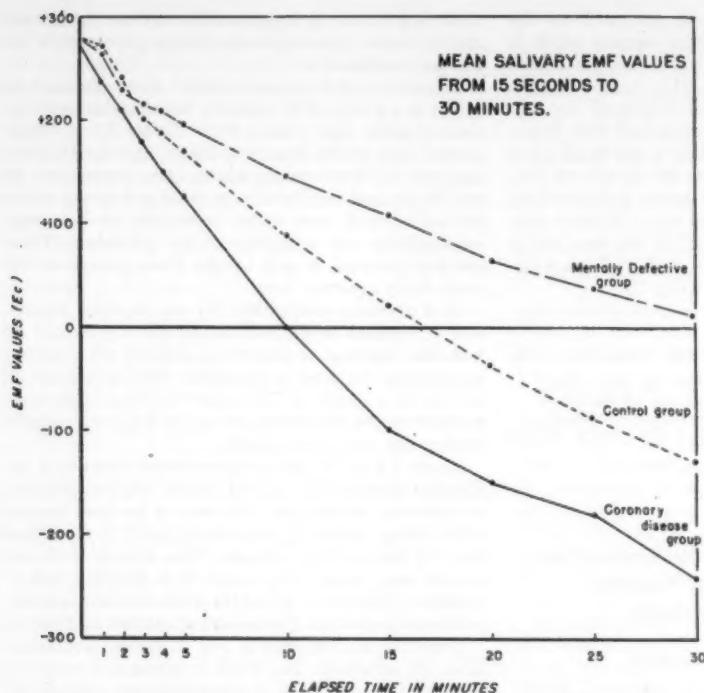


Fig. 1. Reduction-oxidation potentials as a function of time for three groups of individuals: 57 mentally defective males; 66 men who had experienced myocardial infarction; and 77 putatively normal males.

It should be noted that the mean chronological age of the mentally defective group is lower than that of the other two groups. To be certain that the difference in electron-transfer pattern was not a factor of this age difference, a small group of normal control males of mean age 21 was tested. For this group, an average drop at 30 min within 20 mv of the healthy control group, whose mean age was 39, was obtained.

Sharp differences in the rate of declining potential distinguish the groups between 4 and 15 min (Table 2).

In such a study, one would not be justified in disregarding the bacterial content of the saliva, since it is known that saliva contains bacteria and since bacteria in suitable media have been reported to yield

negative oxidation-reduction potentials with time (4). However, there is one important difference between the bacterial reducing pattern and the salivary reducing pattern. Bacteria in media are commonly reported to start the rapid drop toward negativity later than the 30-min period considered in the present experiments, and commonly in the period from 2 to 24 hr. Nevertheless, it seemed worth while to perform salivary bacterial counts on a sampling of our subjects. These did not reveal any definite association between the bacterial counts and the reducing intensity of saliva.

How may the gross differences between the groups in their mean values for intensity of electron transfer in saliva be explained? Since there may be many oxidation-reduction systems in saliva, it would be unreasonable to attribute the entire change to a single oxidation-reduction system. Saliva contains such inorganic ions as I^- and CNS^- . It contains glutathione. Evidence is accumulating for the presence of oxidation-reduction enzymes in saliva. To distinguish and to determine quantitatively the units responsible for the differences between the salivary oxidation-reduction potentials of the mentally defective group and the group subject to coronary infarct prior to the age of 40 yr should be useful in elucidating their basic biochemical differences.

After about 3 min, the electron-transfer patterns (drop in oxidation-reduction potentials) for the three groups studied are consistently and significantly dis-

Table 2. Distribution of cases with respect to salivary oxidation-reduction potentials from 4 to 15 min, inclusive, in coronary heart disease group, normal group, and mentally defective group.

Salivary redox drop from 4 to 15 min, inclusive	Coronary heart disease group (%)	Normal group (%)	Mentally defective group (%)
1-100	25	52	73
101-300	46	25	19
301-500	9	20	7
Over 500	20	3	1

tinguishable. The drop toward negativity is faster, and the negativity obtained is greater on the average for the group who had experienced myocardial infarction prior to the age of 40 than for their comparable "normal" control group. The drop toward negative values is slower, and negativity is not obtained on the average for a group known to be mentally defective.

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3. We are indebted to the following for access to subject material: the Coronary Research Project, Massachusetts General Hospital; the W. E. Fernald State School; and Lever Brothers Company. We also thank Dr. Paul Dunston, for data concerning age, IQ, and clinical diagnosis of the mentally defective group; Dr. Howard Dexter of the Forsyth Dental Infirmary staff, for the salivary bacterial counts; and Dr. Hugo Muench of the Harvard School of Public Health, for his evaluation of the statistical methods employed herein. Dr. M. E. Cohen and Dr. Irwin Sizer offered many helpful suggestions.

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Communications

Preliminary Studies on the Structure of Angiotonin

Angiotonin of a purity 2 to 3 times that of Edman (1) has been obtained by utilizing sodium chloride fractionation, adsorption on and elution from Amberlite IRC-50, and finally partitioning on a Celite column using a butanol-propanol : sodium chloride-acid solvent system (2). By partitioning in a countercurrent apparatus between butanol-propanol and 0.1N hydrochloric acid, an angiotonin was obtained of even greater purity. Only one active pressor principle was evident after 100 transfers. Angiotonin prepared in the afore-described manner was used in the following analyses.

A two-dimensional chromatogram (Fig. 1) of a hydrochloric acid hydrolysate shows 13 different amino acids to be present in the angiotonin molecule. The leucine spot was later shown, by a Dowex-50 column (3), to contain both leucine and isoleucine, making a total of 14 different amino acids.

The amino end-group was determined by the 1:2:4-fluorodinitrobenzene (DNP) method of Sanger (4). The ether soluble fraction from the acid hydrolysis of DNP angiotonin was chromatographed by the method of Biserte and Osteux (5) and found to contain only

DNP aspartic and some dinitroaniline. Only N⁵ DNP lysine was observed in the water-soluble fraction. The fact that only one amino derivative was found is evidence that the angiotonin used here is mainly one entity.

By hydrazinolysis (6) of angiotonin, the amino acid on the carboxyl end could be isolated as the free amino acid. It was then chromatographed (two-dimension) by the same procedure as is illustrated in Fig. 1 and shown to be either leucine or isoleucine.

Chromatographic analysis of the hydrolysate, using a Dowex-50 column (3), gave the amino acids shown in Fig. 1 in the following molecular ratio: 2 aspartic acid, 1 serine, 1 glutamic acid, 2 proline, 1 glycine, 1 alanine, 1 valine, 1 isoleucine, 1 tyrosine, 1 phenylalanine, 2 leucine, 2 histidine, 1 lysine, 2 arginine.

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The Use of Electrically Conducting Glass for Counting Lesions*

A device has been constructed that greatly facilitates counting the local lesions on *Nicotiana glutinosa* which appear after viral infection. The novel feature of this counter is the electric conducting glass employed. Because the glass is frosted and translucent, its entire area can be illuminated softly and evenly

* This work was facilitated by research funds provided by the U.S. Atomic Energy Commission. A sample of EC glass for experimental purposes was supplied by the Corning Glass Works, Corning, N.Y.

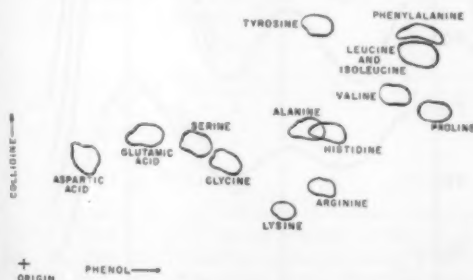


Fig. 1. Two-dimensional chromatogram of an acid hydrolysate of angiotonin, using phenol and collidine as the developing solvents. The amino acids were visualized by spraying with ninhydrin and, after steaming, with diazotized sulfanilic acid.

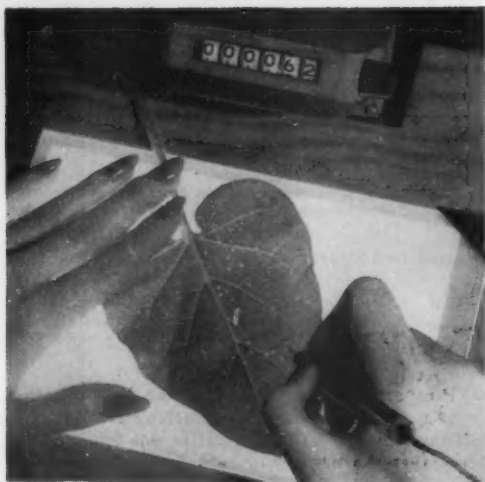


Fig. 1. Counting local lesions on leaf of *Nicotiana glauca* with electrically conducting glass.

by a fluorescent lamp mounted below. As a result, the lesions stand out with great clarity.

The conducting glass is connected to dry cells hooked in series to supply 8 v. Thus, when the delicate leaf tissue next to a lesion is punctured with a metal probe connected to the other pole of the batteries, contact between the probe and glass plate sets up a slight current which trips a relay that calls for 110-v current to activate a reset counter. When the probe is withdrawn, a pinpoint of light shines through the puncture showing that the lesion has been counted (Fig. 1). About 500 lesions on a single half-leaf may be counted in approximately 2 min.

The ease of counting that has been achieved with this device has markedly reduced the strain and boredom previously associated with this task. The cost of the batteries, fluorescent light, counter, relay, glass, and so forth, amounts to about \$40. Batteries appear to last about 2 mo when the counter is used twice each week. Further construction details may be obtained by writing to the authors.

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Received May 10, 1954.

The Spectrum of Magnesium in Concentrated Sulfuric Acid

Niemann and Ikawa (1, 2) have shown that the type and amount of a carbohydrate in solution can be found from its spectrum in the 210 to 400 mμ region in strong mineral acid. In some cases, a quantitative determination of one monosaccharide can be made in an admixture of other monosaccharides, and some polysaccharides can be resolved into their component

monosaccharide units. These determinations are based on the production of various furfurals by the monosaccharides on heating in strong mineral acid, each class of monosaccharides condensing into a slightly different furfural.

In crude preparations of carbohydrates, taken from sea water by extraction on charcoal, alumina, and other adsorbents, a discrepancy of 4 to 5 mg/liter in a total of 20 to 25 mg/liter was noted between the amounts of carbohydrates found by examination of the sulfuric acid spectra in the 210 to 400 mμ region and those found by the N-ethylcarbazole method. Since both methods depend on the formation of a furfural in concentrated sulfuric acid, it was apparent that some compound or compounds other than carbohydrates, could produce ultraviolet spectra similar to those of the furfurals, in hot sulfuric acid.

By a process of elimination, the substance was found to be magnesium. Figures 1 and 2 show the close correspondence between the sulfuric acid spectra of high concentrations of magnesium sulfate and those of a methyl pentose, rhamnose. Certain polysaccharides and some mixtures of monosaccharides duplicate even more closely the spectrum given by magnesium. While the concentrations of magnesium sulfate necessary to give these spectra may seem absurdly high, in working with crude preparations in which the carbohydrate concentration is very low, concentrations of

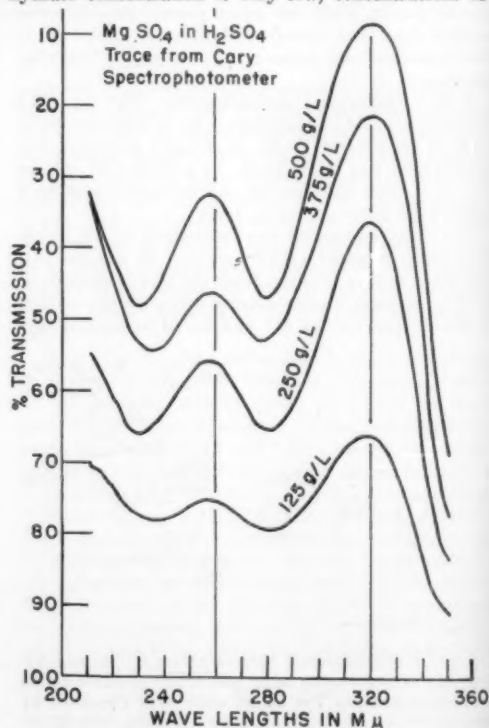


Fig. 1.

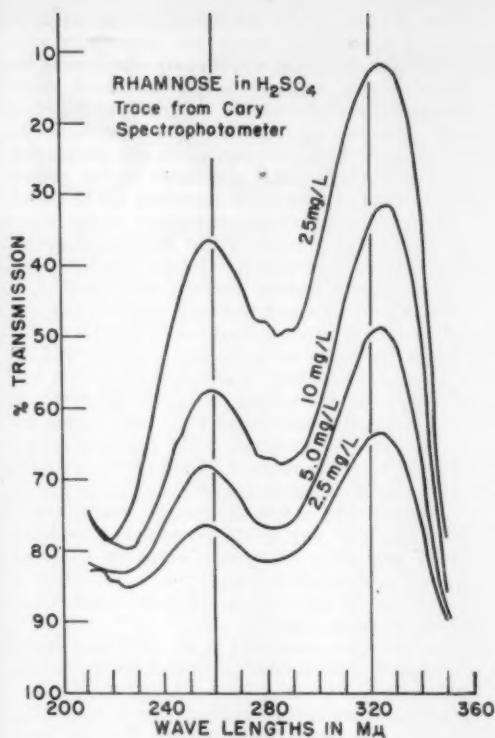


Fig. 2.

magnesium of this order may occur. The normal concentration of magnesium in sea water is about 1.3 g/liter. However, magnesium is picked up very readily by a great number of adsorbents and concentrated easily to 50 or 100 times its normal concentration. Exceedingly thorough dialysis is necessary to remove all traces of magnesium.

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Received January 18, 1954.

On Scientific Writing

Apropos of the Apr. 23 issue of *Science*, concerned largely with the problems of scientific writing, I find in my files the following quotation from a source unknown to me. Other readers may also find this of interest, and perhaps one of them can inform me of its authorship.

ADVICE TO YOUNG WRITERS

In promulgating esoteric cogitations and articulating superficial sentimentalities, philosophical and

psychological observations, beware of platitudinous ponderosity, jejune babblement and asinine affectations. Let your extemporaneous discantings and unpremeditated expiations have intelligibility and vivacity without thraasonical bombast. Sedulously avoid all polysyllabic propensity, psittaceous vacuity and ventriloquial verbosity. Shun double-entendre, imprudent jocosity, and pestiferous polluting profanity either obscure or apparent. Don't call names or use big words, but talk plainly, sensibly and truthfully. All of which is remindful of Disraeli's philippic for Gladstone: He was a sophisticated rhetorician inebriated by the exuberance of his own verbosity.

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Received May 17, 1954.

May I be permitted to give my impressions of Florence Moog's recent communication [*Science* 119, 567 (Apr. 23, 1954)]. That it engages in rather broad generalizations to contend that scientists write poorly and that the censure should have limited itself logically to "some write poorly" is not to be gainsaid. However, when Dr. Moog, to buttress her critical position, brings in such works as Darwin's *Origin of Species*, and inquires whether they weren't highly effective in their own day, she misses the point involved in the problem. Certainly a work such as the *Origin* was most effective; in fact, it was epoch-making even in the early days of its inception; but, the fact remains that if it had been written in a more craftsmanship manner, it would have carried its message across with more simplicity to people who weren't possessed of the avid interest and curiosity of scientists.

Also, it is curious that the very issue in which Dr. Moog has her interesting letter carries an exceptionally valuable contribution by Eugene S. McCartney, titled "Does writing make an exact man?" [p. 525], in which the author points out some of the verbiage used in scientific articles, and so forth, which obfuscates the substance. That when one has things clearly in his mind, he can express them clearly may pertain to many instances; but, I seriously doubt whether this, too, isn't falling into the category of untenable generalization.

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Received April 26, 1954.

Geochronological Significance of Extinct Natural Radioactivity*

An extinct natural radionuclide is defined as an unstable nuclide whose half-life is sufficiently short to have resulted in complete decay since the presumed origin of the elements, yet sufficiently long for its disintegration to have produced effects in nature that can

* This work and the experimental program mentioned herein are being supported by the U.S. Atomic Energy Commission.

be identified. If the universe and the chemical elements are of the order of 4 to 8×10^9 yr old, the half-life would have to be less than 2 or 3×10^8 yr in order for it not to have survived to the present time. If chemical fractionations of elements yielding products that are now accessible took place no earlier than 3×10^8 yr after the formation of the elements, a minimum half-life of about 3×10^7 yr would be required in order that traces of the decay product might be detected unambiguously at the present time. No nuclides are known with half-lives definitely between 2.4×10^7 yr (U^{236}) and 7.1×10^8 yr (U^{235}).

Although helium production (1) and heat evolution (2) by now-extinct nuclides may have been important early in the history of the earth, such non-specific effects would be difficult to identify and assign. It has been postulated that certain pleochroic haloes were formed by alpha emitters which have subsequently vanished (3), but the evidence is hardly convincing. The clearest manifestation of an extinct radioactivity would be the occurrence of its decay product in abnormal abundance in a portion of matter such as a meteorite (4, 5), geochemical phase (6, 7, 8), planet (6), or terrestrial mineral (9) that had once contained the unstable nuclide. It has been pointed out (4) that the presence or absence of such effects can give information about the interval between the formation of the elements and the formation of the phase in question, and several applications of this principle have been made (5, 6, 7, 8). A principal objective has been to arrive at an estimate of the age of the elements and possibly of the universe.

It is the purpose of this note to indicate that extinct natural radioactivity, if it should exist and be detectable, should be useful for determining the times of ancient geologic events associated with the formation of appropriate minerals or geochemical phases. There would exist a functional relationship between the age of a mineral that once contained an extinct natural radionuclide and the quantity of the radiogenic product: the ratio of the radiogenic product (corrected in the usual way for the nonradiogenic portion originally incorporated into the mineral) to the amount of a stable (or long-lived) isotope of the extinct activity would decay exponentially. From this relationship, a relative chronology for such minerals could be established, allowing determination of relative times for geologic events in widely separated parts of the earth. It might be possible to derive the "cosmic decay curve" for the extinct activity from independently determined ages of the minerals. Alternatively, the slope of the semilogarithmic curve could be established by a laboratory determination of the half-life. With one fixed time point, the absolute age of any such analyzed mineral could be read off of the curve.

This method would be particularly useful for study-

ing the earliest part of the history of the earth. It would be increasingly precise for increasingly aged minerals and, therefore, would nicely complement the existing methods based on long-lived natural radioactivity, which yield dates of low precision for early events. Since the time scale could be fixed relative to the present, it would not depend on any assumption regarding the primordial abundance of the extinct nuclide, or on any postulate regarding the origin of the elements of the universe at large.

A statistical examination of the lifetimes of known β -labile nuclides near stability (10) and considerations of the probable or possible nuclear properties of those that are unknown suggest that there may well be a few having half-lives within a factor of ~ 3 of 10^8 yr. To be useful for geochronometry, such a nuclide and its daughter must each have a stable or long-lived isotope. They must, furthermore, belong to elements that are geochemically fractionated to an appreciable extent. The latter requirement would probably render Sm^{146} , whose lifetime has been reported to be $\sim 5 \times 10^7$ yr (11), of little value in this connection.

An experimental search for extinct natural radionuclides is under way in our laboratories, involving artificial production of nuclides suspected of being long-lived and isolation from selected minerals and meteorites of the hypothetical daughter elements for mass-spectroscopic analysis.

These ideas were discussed at an AEC Raw Materials Research Information meeting at the University of Arkansas in Nov. 1951, at the AAAS Gordon Research Conference on Nuclear Chemistry in June 1952, and at the NRC-NSF Conference on Nuclear Processes in Geologic Settings at Williams Bay, Wis., in Sept. 1953. A detailed discussion of the possibilities of occurrence and of the potential significance of extinct natural radioactivity will be published in the *Annals of the New York Academy of Sciences*.

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References and Notes

1. R. S. Adams and C. E. Watson, *J. Biol. Chem.* **147**, 460 (1943).
2. Dicumarol is the trademark for. . .
3. S. H. Aston, *An Introduction to Biochemistry* (Street & Smith, New York, ed. 3, 1948), p. 36.
4. White's determination of this factor involves. . .

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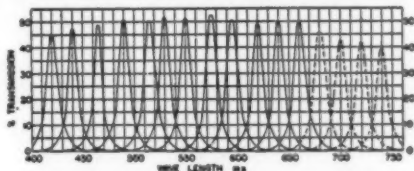
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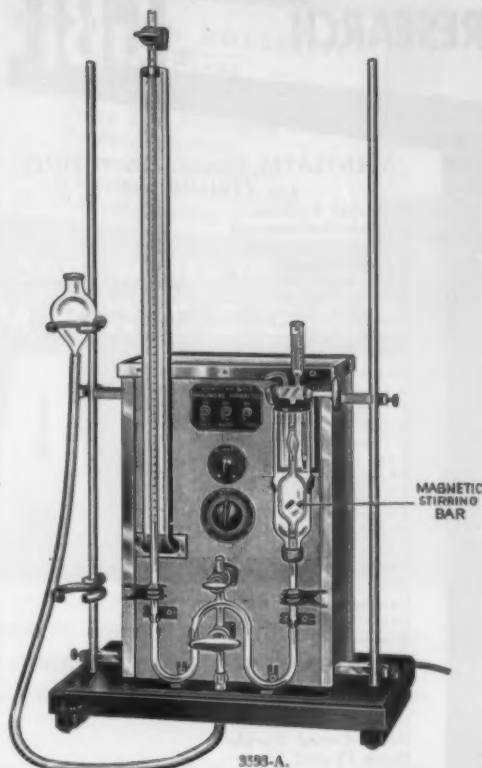
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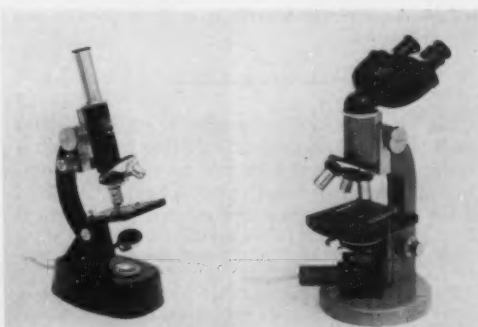
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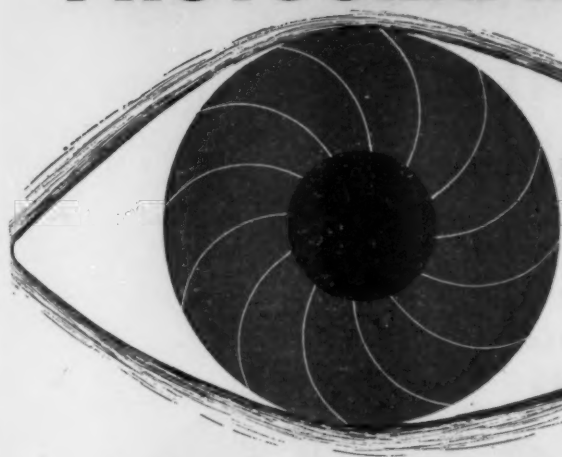
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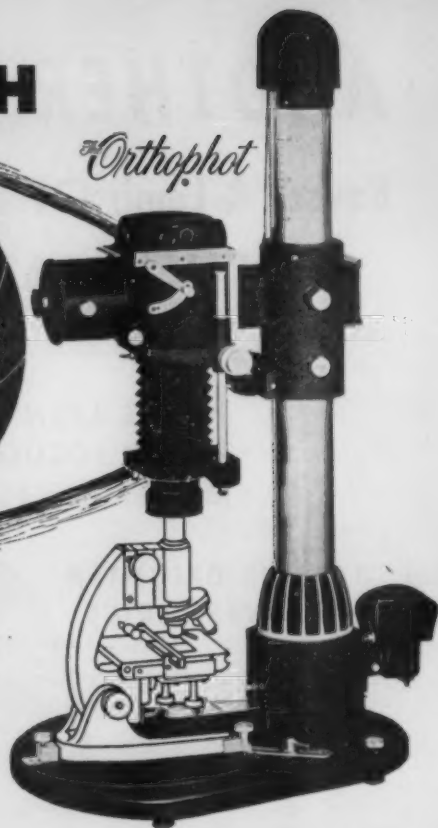


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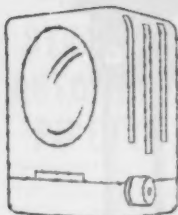
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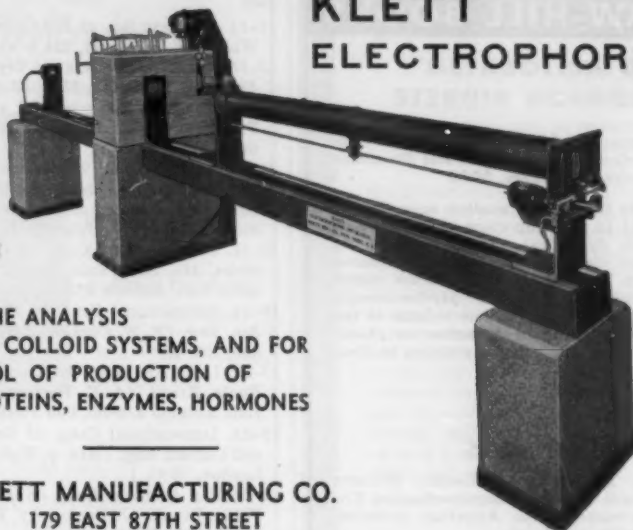
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- 13-17. Conf. on Defects in Crystalline Solids, Bristol, Eng. (H. A. Barton, 57 E. 55 St., New York 22.)
- 13-17. Cong. on Experimental and Theoretical Nuclear Physics, Glasgow, Scotland. (H. A. Barton, 57 E. 55 St., New York 22.)
- 15-17. International Symposium on Solid Particles in Astronomical Objects, Liège, Belgium. (P. Th. Oosterhoff, Leiden Observatory, Leiden, Netherlands, or O. Struve, Univ. of California, Berkeley 4.)
- 15-21. Pan American Cong. of Child Welfare and Pediatrics, 4th, São Paulo, Brazil. (J. Ramos, Av. Brigadeiro Luiz Antonio 278-80, São Paulo.)
- 16-21. International Conf. on Electron Microscopy, London, Eng. (F. W. Cuckow, Royal Cancer Hospital, London, SW 3.)
- 17-22. Latin American Cong. on Mental Health, 1st, São Paulo, Brazil. (A. C. Pacheco e Silva, Av. Brigadeiro Luiz Antonio 278-80, São Paulo.)
- 19-23. International Cong. of Gerontology, 3rd, London and Oxford, Eng. (Mrs. A. Humpage, Tavistock Square, London, W.C. 1.)
- 19-24. Pan American Cong. on Gastroenterology, 5th, São Paulo, Brazil. (J. Ramos, Av. Brigadeiro Luiz Antonio 278-80, São Paulo.)
- 19-31. French Assoc. for the Advancement of Science, Poitiers, France. (FAAS, 28 Rue Serpente, Paris 8.)
- 20-24. International Conf. on Thrombosis and Embolism, Basel, Switzerland. (W. Mers, Gynecological Clinic, Univ. of Basel.)
- 21-24. International Cong. of Medical Psychotherapy, Zurich, Switzerland. (H. K. Fiers-Monnier, Hauptstrasse 8, Kreuzlingen, Switzerland.)
- 21-23. International Cong. of Crystallography, 3rd, Paris, France. (J. D. H. Donnay, Johns Hopkins Univ., Baltimore, Md.)
- 23-29. International Cancer Cong., 6th, São Paulo, Brazil. (H. L. Stewart, National Cancer Inst., Bethesda, Md.)
- 25-31. Inter-American Cong. of Sanitary Engineering, 4th, São Paulo, Brazil. (L. Nogueira, Caixa Postal 8099, São Paulo.)
- 26-31. International Cong. of Gynecology and Obstetrics, Geneva, Switzerland. (W. Geisendorf, Maternité, Hôpital Cantonal, Geneva.)
- 27-28. International Union of Theoretical and Applied Mechanics, 4th, Brussels, Belgium. (H. L. Dryden, 1724 F St. NW, Washington 25, D.C.)
- 28-2. International Union for the Protection of Nature, 4th, Copenhagen, Denmark. (H. J. Coolidge, National Research Council, Washington 25, D.C.)
- 28-2. Symposium on Photoelasticity and Photoplasticity, Brussels, Belgium. (H. L. Dryden, 1724 F St., NW, Washington 25, D.C.)

August

- 1-2. Linguistic Soc. of America, Chicago, Ill. (A. A. Hill, 1719 Massachusetts Ave., NW, Washington 6, D.C.)
- 3-13. Pan American Federation of Engineering Societies, 3rd, São Paulo, Brazil. (H. Pegado, Edifício Maua, Viaduto Dona Paulina, São Paulo.)

(See the May 21st issue for summer meeting lists.)

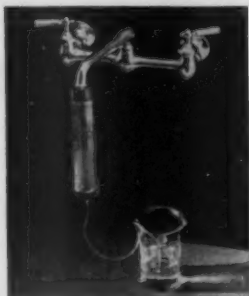
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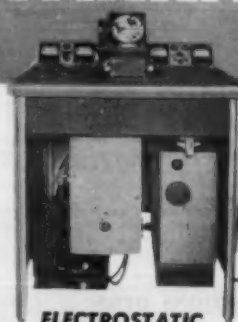
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